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The Engineer

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An Engineer's Note Book of the 18th Century.

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PUBLIC NOTICES

The Norton and Gregory Annual SCHOLARSHIPS IN ENGINEERING.

Offered by NORTON and GREGORY, Ltd., London.

HONORARY COMMITTEE:
Sir JOSEPH PETAVEL, K.B.E., D.Sc., F.R.S., Director of the National Physical Laboratory, Teddington (Chairman).
Professor C. E. INGLIS, M.A., Professor of Engineering, Cambridge University (Vice-Chairman).
Professor E. G. COKER, D.Sc., F.R.S., Dean of the Faculty of Engineering, University of London, University College, Gower-street, W.C. 1.
J. TALBOT, Esq., T.D., M.A., B.Sc., Master of Hailerbury College (Appointed by the Committee of the Headmasters' Conference).
G. H. BURKHARDT, Esq., M.A., M.Sc., Principal of Swindon and North Wilts Secondary School and Technical Institution, Swindon (Appointed by the Incorporated Association of Headmasters).
Together with the Chairman and the Managing Director of Messrs. Norton and Gregory, Ltd.

Messrs. Norton and Gregory, Ltd., offer Two Engineering Scholarships to be competed for annually, one value £100 per annum, and one value £50 per annum, tenable for three years at any University in the United Kingdom or British Dominions approved by the Committee.

A sum sufficient to cover the Scholarships now offered has been deposited by the Donors in the names of the Chairman and Vice-Chairman of the Committee.

Candidates must have reached the age of 17, but not the age of 19, on 1st March in the year of Examination, be domiciled in the United Kingdom, and undertake to pursue a three years' course in Engineering with a view to following it as a profession.

Papers, which will cover two days' Examination, will be set in the following four subjects:—
English.
Mathematics.
Mechanics.
General Physics.

The Examination for the 1923 Scholarships will be held in March at a date to be fixed later, and all Application Forms must reach the Committee not later than 15th February, 1923.

Full particulars and official Application Forms may be obtained from
The SECRETARY,
SCHOLARSHIPS COMMITTEE,
Messrs. Norton and Gregory, Ltd.,
1 and 2, Castle-lane,
1264 Westminster, London, S.W. 1.

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for: ONE 15-TON OVERHEAD ELECTRIC TRAVELLING CRANE.

Specification and form of Tender can be obtained at the Company's Offices, 122, Gresham House, Old Broad-street, London, E.C. 2, on or after 18th January, 1923.

A fee of £1 1s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Friday, 2nd February, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. C. VOLKERS,
1310 Secretary.

Borough of Portsmouth.

MAIN DRAINAGE—CONTRACT NO. 7.
TO MANUFACTURERS OF PLUNGER PUMPS AND STEAM ENGINES.

The Corporation of Portsmouth is prepared to receive TENDERS for the CONSTRUCTION, DELIVERY and ERECTION of FOUR PLUNGER PUMPS, 23½in. diameter and 2ft. 3in. stroke; AIR VESSELS, VALVES, and other matters connected therewith; also for the OVERHAUL of TWO existing STEAM ENGINES, in accordance with drawings, general conditions and specification, copies of which may be obtained at the office of the Engineer, Mr. G. Midgley Taylor, of John Taylor and Sons, 36, Victoria-street, S.W. 1, upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

These documents will only be issued to bona fide makers of plunger pumps and steam engines.

Sealed Tenders, endorsed "Main Drainage Contract, No. 7," addressed to the Town Clerk, are to be delivered at his office at the Town Hall, Portsmouth, at or before 9 a.m. on Friday, 23rd February, 1923.

The Corporation does not bind itself to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.

Town Clerk's Office,
The Town Hall,
Portsmouth.
16th January, 1923. 1283

Isle of Man Harbours.

TO DREDGING CONTRACTORS.

The Isle of Man Harbour Commissioners are prepared to receive TENDERS for certain DREDGING (about 15,700 cubic yards of marly clay and 3000 cubic yards of schistose rock), to be done at Douglas, Isle of Man.

Copies of the specification, form of Tender, and drawings may be obtained from W. H. Blaker, Esq., Assoc. M. Inst. C.E., the Engineer to the Commissioners, at the undermentioned address, on payment of £2 2s., which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Douglas Dredging," must be in the hands of the undermentioned not later than Monday, February 5th, 1923.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
A. W. TONGUE,
Secretary.

Isle of Man Harbour Commissioners' Offices,
Douglas, Isle of Man,
16th January, 1923. 1298

County Borough of Halifax.

The Tramways and Electricity Committee of the Halifax Corporation are prepared to accept OFFERS for the PURCHASE of a 750 K.W. DIRECT-COUPLED BELLISS ENGINE and ELECTRIC CONSTRUCTION CO.'s DIRECT-CURRENT DYNAMO, 450 to 560 volts, together with a SURFACE CONDENSER.

Full particulars can be obtained on application to Mr. W. M. Rogerson, M. Inst. E.E., Borough Electrical Engineer, Electricity Department, 29, Northgate, Halifax.

The highest or any Tender will not necessarily be accepted.

Tenders to be delivered to the undersigned not later than Twelve Noon on Tuesday, February 6th, 1923.

By Order,
PERCY SAUNDERS,
Town Clerk

Town Hall, Halifax,
15th January 1923 1252

PUBLIC NOTICES

County of London.

The London County Council invites TENDERS for the SUPPLY and DELIVERY in London of about 2300 TONS of STANDARD STEEL GIRDER TRAMWAY TRACK RAILS, LIPLESS TRACK RAILS and RENEWABLE GUARD RAILS, with FASTENINGS therefor; and, alternatively, of about 4900 TONS of such RAILS, with FASTENINGS therefor. The drawings, specification, bills of quantities, form of Tender, and other particulars may be obtained on application to the Chief Engineer of the Council, at the Old County Hall, Spring-gardens, S.W. 1, upon payment to the Cashier of the Council of the sum of £2. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. All particulars may be obtained on application at the Old County Hall before payment of this fee.

Tenders must be addressed to the Clerk of the Council and delivered at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 12th February, 1923. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1268 Clerk of the London County Council.

Metropolitan Water Board.

TENDER FOR PIPE LAYING, REPAIRS, ALTERATIONS TO MAINS, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, REPAIRS, ALTERATIONS to MAINS, &c., within the areas of their Kent, Northern, Southern, and Western Districts, for the periods of six or twelve months from 1st April, 1923.

Tenders must be made on official forms, which may be obtained from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, on and after Wednesday, 24th January, 1923, by personal application (Room 155), or upon forwarding a stamped addressed brief envelope. Applicants should refer to the number of the Tender (No. 17).

Tenders, enclosed in sealed envelopes, addressed to the "Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1" endorsed "Tender for Pipe Laying," must be delivered at the offices of the Board not later than 11 a.m., Wednesday, 21st February, 1923.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Acting Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
15th January, 1923. 1260

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—
1. SCREWS, &c.
2. PORTLAND CEMENT.
3. CANVAS.
4. LINOLEUM.
5. BUNTING, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Screws, &c.," or as the case may be, must be left with the undersigned not later than Twelve Noon on Tuesday, the 30th January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge which will not be returned, will be made of 2s. 6d. for each copy of Specification No. 1 and of 5s. for each of Specifications Nos. 2, 3, 4, and 5.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
12th January, 1923. 1259

PUBLIC NOTICES

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification may be obtained or inspected upon application to—
The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/7.—MOTORS, STARTERS, and ISOLATING SWITCHES.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A third, or any further copies, will be supplied for the sum of 10s. 6d. each, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £40 is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed, and addressed, must be delivered to the undersigned in Melbourne, not later than Noon on March 15th, 1923.

R. LIDDELOW,
Secretary.
State Electricity Commission of Victoria,
1305 Melbourne, Australia.

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following PLANT for the Morwell Power Scheme.

Copies of Tender form and specification may be inspected or obtained upon application to—
The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/9.—TRANSFORMERS and SPARES.

CHARGE.—10s. for first two copies of Tender form, specification and contract conditions complete. This charge will be returned on receipt of a bona fide Tender.

A third, or any further copies, may be obtained on payment of 5s. per copy, not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £10 is required to be lodged with Tender.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed, and addressed, must be delivered to the undersigned in Melbourne, not later than Noon on April 23th, 1923.

R. LIDDLELOW,
Secretary,
State Electricity Commission of Victoria,
1306 Melbourne, Australia.

Government of Bengal.

APPLICATIONS are INVITED for the POST of CHAIRMAN of the CALCUTTA PORT COMMISSIONERS. The salary proposed is Rs. 5000 per mensem, in addition to which free quarters (or a house allowance in lieu thereof) and a motor car would be provided.

The post would be a whole-time appointment.

Applications, in which candidates are invited to state their qualifications, should be addressed to
The Deputy Secretary to the Government of Bengal,
Marine Department,
Calcutta,
from whom any further information can be obtained.

Applications must be submitted before the 1st March, 1923.

G. H. W. DAVIES,
Deputy Secretary to the Government of Bengal.

Marine Department,
Writers' Buildings, Calcutta,
The 7th December, 1922. 1249

PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

No.		Fee for Specification.
1.	SOLID DRAWN STEEL BOILER TUBES	£1
2.	STRAIGHT AXLES (FORGINGS) and CRANK AXLES (MACHINED)	£1
3.	SPRING STEEL	10s.
4.	STEEL SCREW COUPLINGS, &c.	£1
5.	STEEL TYRES for LOCO. ENGINES	£1

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Solid-drawn Steel Boiler Tubes," or as the case may, not later than Eleven o'clock a.m. on Tuesday, the 30th January, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 17th January, 1923. 1294

Burgh of Dumfries.

ELECTRICAL ENGINEER AND MANAGER.

APPLICATIONS are INVITED for the POSITION of ENGINEER and MANAGER of the Corporation Electricity Supply Undertaking.

Applicants should have experience of the operation of modern steam generating plant, also A.C. and D.C. distribution systems. Applicants must state salary required and state age, present employment, and give particulars of training and experience. There is a free house with electric light and rates. Copies of recent testimonials should be enclosed, four copies of each being sent.

Applications to be lodged with the Town Clerk, Town Hall Buildings, Dumfries, not later than 31st January current.

R. A. GRIERSON,
Town Clerk.

Town Clerk's Office, Dumfries,
15th January, 1923. 1272

Hitchin Urban District Council WATERWORKS.

CLERK OF WORKS REQUIRED, to Take Charge of and Superintend the Erection of a 300,000 gallons Reinforced Concrete Receiving Tank at the Council's Pumping Station, Hitchin. The work will take from 14 to 16 weeks. Salary £5 per week.

Application to be made by letter only, stating previous experience in reinforced concrete construction, to the CLERK, Urban District Council Offices, Hitchin, Herts. Copies only of three recent testimonials as to capability to be enclosed with application. 1309

The Commissioners for the PORT OF CALCUTTA.

APPLICATIONS are INVITED for ONE EXECUTIVE ENGINEER and for SIX ASSISTANT EXECUTIVE ENGINEERS with the following qualifications:

EXECUTIVE ENGINEER.—A Civil Engineer who is a Corporate Member of the Institution of Civil Engineers and who has had good experience on Dock Construction, preferably as a contractor's staff. Age about 35 years. Salary Rs. 1100 per month, rising by Rs. 50 to Rs. 1500 per month.

ASSISTANT EXECUTIVE ENGINEERS.—Civil Engineers who have had technical education in engineering, are physically fit and energetic, and who have had some experience on Dock Construction. Preference will be given to men who have passed the examination for Associate Member of the Institution of Civil Engineers or hold an exempting degree. They should be unmarried and age about 27 years. Salary Rs. 700 per month, rising by Rs. 50 to Rs. 1050 per month.

Applications, with copies of testimonials, to be sent to the undersigned not later than Monday, 29th January, 1923.

J. ANGUS, M. Inst. C.E.,
Consulting Engineer and London Agent.

10, Prince's-street,
Westminster, S.W. 1. 1266

SITUATIONS OPEN

WANTED, YOUNG MAN, Age not Exceeding 25 years, as ASSISTANT to the CHIEF ENGINEER in a large Rolling Stock Works in Yorkshire.

Only applicants who have had a thorough technical training, preferably at one of the Universities, will be considered. This is a first-class opening with excellent prospects for the right man.

Address, stating age, salary required, and experience, 1243, The Engineer Office. 1243 A

MANAGER REQUIRED for Firm on Tyneside, manufacturing Scientific Instruments used in connection with Power Plants; one having had experience with Distance Thermometers preferred. State age, qualifications and remuneration expected.—Address, P6677, The Engineer Office. P6677 A

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SITUATIONS OPEN (continued)

ASSISTANT ENGINEER WANTED in London for Mechanical Engineer's Office. Well versed in estimating and correspondence. Good technical and commercial knowledge essential. Experience in water power plant most desirable. Commencing salary £300 per annum.—Address, 1290, The Engineer Office. 1290 A

COUNTRY TRAVELLER WANTED by First-class Manufacturers. Must be Foundryman or Engineer, preferably with experience in the Sale of Die Castings and White Metals.—Address, 1255, The Engineer Office. 1255 A

DESIGNING ENGINEER for Switchgear WANTED in London area. Applicants must have intimate knowledge of up-to-date designs. Sound practically and technically.—Address particulars of age, salary, and experience, 1276, The Engineer Office. 1276 A

ENERGETIC and Capable YOUNG MAN WANTED for Steel Foundry (Electric) in Scotland as TECHNICAL ASSISTANT to the Foundry Manager. Applicants, who should have some experience of general Steel Foundry practice, should give particulars of age, education, previous experience, salary required, when free.—Address, 1313, The Engineer Office. 1313 A

ENGINEER REQD. for Peru; Sound Previous Exp. of Sugar Machinery essential. Single pref., age 28/35.—Apply, LAURIE and CO., Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. P6710 A

LIVE REPRESENTATIVE REQUIRED for Midlands by well-known Woodworking Machinery Manufacturers. Send fullest particulars, stating age, previous experience, salary and commission required.—Address, P6735, The Engineer Office. P6735 A

REQUIRED, WATERWORKS TOWN SUPERINTENDENT. Must have experience of Distribution in all branches, Main Laying, Plumbing Work and Estimating for same. Some draughtsmanship and keeping of pipe plans. Good management of men essential. Population of town 60,000. Age from 30 to 45. Application in own handwriting with three recent testimonials. Salary £360 per annum.—Address, 1282, The Engineer Office. 1282 A

TECHNICAL ASSISTANT to CHIEF ENGINEER REQUIRED, to carry out work in connection with Reconstruction of Iron and Steel Works. Applicants must have had large experience in modern electrically driven Iron and Steel Works, including modern Blast-furnaces, Plate Rolling Mills, &c., and be capable of dealing with general schemes, estimating and the specification of materials for ordering. State age, salary expected, and experience to SECRETARY, Consett Iron Company, Limited, Consett, Co. Durham. 1253 A

SALES ENGINEERS REQUIRED, One Senior, two Juniors; must have had Drawing-office experience; good prospects to real order getters. State education, experience, age and salary required.—Address, 1172, The Engineer Office. 1172 A

SALES MANAGER WANTED by North-East Firm manufacturing Colliery Plant, Engineering Castings, &c.—Address, stating age, experience and salary required, 1303, The Engineer Office. 1303 A

WATER POWER.—WANTED, for Water Turbine Department of large Company in London, CHIEF ASSISTANT ENGINEER, experienced in Laying Out and Tendering for Water Power Installation; general knowledge of Turbine Design advantageous. State age, salary, when free, previous experience, and attach copies of testimonials.—Write, Box 633, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 1260 A

WANTED by Leading Firm in Lancashire, First-class SENIOR DRAUGHTSMAN to Take Charge of Slow-speed Steam Engine Section of Drawing-office; up-to-date experience in the Design of Drop Valve and Uniflow Engines essential.—Address, stating age, experience and salary required, 1159, The Engineer Office. 1159 A

WANTED, Experienced SHIPS' DRAUGHTSMAN for small yard, capable of personally laying off vessels in mould loft. Man with knowledge of Marine Engineering preferred.—Apply by letter, THE MEDWAY SHIPBUILDING and ENGINEERING CO., Rochester. 1247 A

CONSTRUCTIONAL DRAUGHTSMAN WANTED, used to estimating Light Steel Work, Fireproof Doors, &c.—Address, stating wages, 1296, The Engineer Office. 1296 A

DRAUGHTSMAN, Experienced in the Design of Small Mechanical Details and in Modern Workshop Practice, REQUIRED in an Electrical Engineers' Office in the West of London. State age, experience, and salary required.—Address, 1284, The Engineer Office. 1284 A

DRAUGHTSMEN REQUIRED by Leading Firm of Engineers for their London Office. Preference given to applicants with Crane Experience.—Address, stating age, experience, and salary required, 1265, The Engineer Office. 1265 A

DRAUGHTSMAN REQUIRED for Engineers' London Office, thoroughly experienced in Designing and Laying Out Mechanical Handling Plants for Coal, Ore, &c. Only men with first-class experience as above need apply. State experience, age, and salary required, and when at liberty.—Address, 1288, The Engineer Office. 1288 A

DRAUGHTSMAN REQUIRED for S.W. District, London; experienced in Structural Steel Work. State age, experience, salary required, &c.—Address, P6711, The Engineer Office. P6711 A

DRAUGHTSMAN WANTED, Experienced in Boilerhouse Design (Lancashires), Steam Mains, Auxiliaries, &c. Must be up-to-date and able to prepare specifications and estimates.—Apply by letter only, CHIEF ENGINEER, 99, Leman-street, London, E. 1. 1277 A

DRAUGHTSMAN WANTED, Fully Experienced in Railway Companies' Carriage, Wagon and Steel Car Work.—Apply by letter only, stating age, salary, experience, to METROPOLITAN CARRIAGE COMPANY, Saltley, Birmingham. 1174 A

SENIOR DRAUGHTSMAN for Large Firm of Electrical Manufacturers; must have first-class experience of Electrical Motors of varying sizes. State age, experience and salary required.—Address, 1178, The Engineer Office. 1178 A

STRUCTURAL DRAUGHTSMAN.—WANTED for Manchester district, First-class DRAUGHTSMAN, able to design, make workshop details, and take out estimate quantities. Good opening for really first-class man.—Address, stating age, detailed experience, and salary required, 1275, The Engineer Office. 1275 A

WATER TURBINES.—LEADING DRAUGHTSMAN REQUIRED IMMEDIATELY for Detail Design and Manufacturing Drawings of all types of Water Turbines. Must be thoroughly efficient and experienced man. Also SENIOR and JUNIOR DRAUGHTSMEN WANTED for Steam Turbine Details.—Apply, with full particulars of training, experience, age, and salary expected, to CHIEF DRAUGHTSMAN, English Electric Co., Ltd., Willans Works, Rugby. 1262 A

WANTED for Shift Work, a DIESEL ENGINE DRIVER, used to the Running and Maintenance of Large Units.—Address, 1263, The Engineer Office. 1263 A

SITUATIONS WANTED

A PUBLIC SCHOOL MAN (23) DESIRES SIT.; 3 yrs. shops, 3 yrs. D.O. designing, estimating, testing, erecting, marine, steam and hydraulic work.—Address, P6724, The Engineer Office. P6724 B

ASSISTANT MANAGER DESIRES SIMILAR POSITION; sound works and technical experience with general engineers and ironfounders; capable organiser, well educated, excellent reference.—Address, P6696, The Engineer Office. P6696 B

ASSOC. M. Inst. C.E., with Small Capital, I.C. engine and general mechanical, shops and office, also land drainage and surveying, DESIRES OPENING with Engineer or Firm with view to Partnership.—Address, P6713, The Engineer Office. P6713 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 615, c/o Deacon's, Leadenhall-street, E.C. 1225 B

CIVIL ENGINEER (24), B.Sc. (Eng.), 3½ Years' pract. exper., good surveyor and draughtsman, DESIRES SIT., waterworks, hydro-elec., or roads.—Address, P6722, The Engineer Office. P6722 B

COLD-STARTING OIL ENGINES.—Young ENGINEER DRAUGHTSMAN, with exceptional experience in design and experimental work with large gas and oil engine firm, DESIRES CHANGE as Engineer Draughtsman or Salesman Engineer at home or abroad. Age 23.—Address, P6717, The Engineer Office. P6717 B

COMMERCIAL ENGINEER (26), Home Trained, REQUIRES POST; considerable experience in India, above capacity; knowledge Eastern markets, estimation, buying, selling, erecting, flour, oil, sugar mills, hydraulic, steam, oil power plant, native labour, Hindustani.—Address, P6730, The Engineer Office. P6730 B

DIESEL ENGINEER, Ten Years' Experience Diesel and hot-bulb engines, specialised two-stroke marine engines, shortly disengaged, SEEKS responsible POSITION, Works or Sales Dept. Principals only.—Address, P6738, The Engineer Office. P6738 B

ENGINEER, Dipl. M.E. (23), SEEKS POST as ASSISTANT with good firm. Experienced in general engineering, ropeways, conveyors, &c., shops and D.O.—Address, P6709, The Engineer Office. P6709 B

ENGINEER, Ex-Officer, 5 Years' Experience, pattern, foundry, fitting, erecting manufacturing machinery, Diesel, internal combustion; technical knowledge, would REPRESENT FIRM, Scotland; French and German.—1295, The Engineer Office. 1295 B

ENGINEER, Mechanical Marine, Extra Ch. Certif., D.O. experience, highly qualified practical and theoretical work, WISHES EMPLOYMENT. Experienced in survey of vessels and machinery, reports, supervision, taking full responsibility. Moderate salary until worth proved.—Address, WILSON, 11, Aubrey-road, London, N. 8. P6706 B

ENGINEER (25), Mechanical, 9 Years' Experience (5 years' apprentice well-known firm, 3 years technical), DESIRES START as ASSISTANT.—Address, P6726, The Engineer Office. P6726 B

ENGINEER REQUIRES APPOINTMENT: First-class experience as fitter, turner and millwright, gas, steam and petrol engines and general work; maintenance or production.—"ENGINEER," c/o W. Fowler, 7, Arvon-road, Highbury. P6725 B

ENGINEER SEEKS POSITION of Responsibility, home or abroad. Presently employed as assistant maintenance engineer. Knowledge of building; technically trained; age 24 years.—Address, P6737, The Engineer Office. P6737 B

ENGINEER (43), Who Has Just Completed Liquidation of large metal concern, DESIRES ENGAGEMENT; 18 years' experience as manager and assistant manager; London district preferred.—Address, P6719, The Engineer Office. P6719 B

ENGINEER, Young, Single, French Engineering graduate, fluent English, French, German, Polish and Russian, many years' practical experience with leading English firms, DESIRES APPOINTMENT.—"ENGINEER," 2 Franconia-road, S.W. 4. P6685 B

HAS Any MANUFACTURER an OPENING for a YOUNG ENGINEER; grammar school education and 3 years' production experience, shops, D.O., and sales?—Address, P6712, The Engineer Office. P6712 B

PLEASE NOTE.—ENGINEER, 18 Years' Experience, including inspecting, rate fixing, progress, drawing-office, estimating, also keen high-grade SPECIALITY SALESMAN, with connection amongst engineers, contractors, shipbuilders, manufacturers, DESIRES RE-ENGAGEMENT.—Address, P6739, The Engineer Office. P6739 B

SCOTTISH ACCOUNTANT, at Present Holding appointment as works secretary and commercial manager in large engineering works, DESIRES RESPONSIBLE APPOINTMENT in Midlands or South of England; extensive knowledge of works finance and executive control, also of best markets for the purchase of all engineering requisites; strict disciplinarian; excellent references can be furnished; interviews desired at advertiser's expense, if necessary.—Address, P6690, The Engineer Office. P6690 B

STEEL STRUCTURES.—CIVIL ENGINEER, A.M. I.C.E., with many years' experience on construction of large steel and concrete buildings, WANTS responsible POST.—Address, P6728, The Engineer Office. P6728 B

TRAINED ENGINEER, with Excellent Commercial and technical experience, young, active and with initiative, SEEKS POSITION as Sales Manager or Traveller. Highest references; now at liberty.—Address, P6704, The Engineer Office. P6704 B

WILL Any Mechanical or Electrical Engineering FIRM OFFER an intelligent and energetic YOUNG MAN a POSITION as JUNIOR DRAUGHTSMAN? Two years' home study in tracing, detailing, and working drawings.—Address, 65, Tasker-street, Walsall. P6718 B

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Cobalt Steels for Permanent Magnets.

By J. FERDINAND KAYSER, Assoc. Met.

PART I.

DURING the last few years the development of permanent magnet steels has been so great and rapid as almost to outrival in importance the development of high-speed steels witnessed at the end of the nineteenth and beginning of the twentieth centuries. In a paper published in the *Journal* of the Institution of Electrical Engineers in 1913 and delivered to the Glasgow Local Centre, Dr. S. P. Thompson indicated as a possible goal for an ambitious magnet maker the production of a magnet giving a remanence of about 10,000 and a coercive force of 80.* The facts of 1922, however, far exceed the ideals of 1913, and magnets giving remanences of from 8000 to 10,000 and coercive forces as high as 230 are being manufactured on a large scale. This great advance has been made possible by the discovery that the addition of cobalt to certain steels gives, when the samples are suitably hardened, an extremely high coercive force.

The effect of cobalt upon the magnetic properties or iron was first investigated about 1912 by Professor Pierre Weiss, of Zürich, who drew attention to the existence of an alloy, the composition of which corresponds to the formula Fe_2Co, which has a saturation density about 15 per cent. greater than that of pure iron, and which is in some respects superior to pure iron as a ferro-magnetic material.

About the end of 1915, Mr. P. R. Kuehnrich began his researches on the cobalt chromium tool steels, and the effect of cobalt upon the magnetic properties of such steels was first observed during magnetic tests incidental to an investigation on tool steels containing different percentages of cobalt. Cobaltcrom tool steel containing 3½ per cent. Co has a coercive force twice as great as tungsten magnet steel, and was actually used as a magnet steel to a limited extent.

During 1919 news came to England that Professor Honda had been responsible for considerable investigations on magnet steels containing from 20/60 per cent. of cobalt. His preferred analysis was for a steel containing 35 per cent. cobalt. Such a steel gives, when the other ingredients are suitable and after proper heat treatment, a remarkably high coercive force, and his figures soon attracted the attention of some of the leading electrical engineers of this country.

It was realised in Sheffield that cobalt was such an expensive metal that steels such as the above could not be a commercial proposition except under a few special circumstances where the cost of the magnet could be ignored. Cobaltcrom steels having already exhibited striking magnetic properties, were hence further developed, and the work resulted in the discovery that for a required energy content a cobaltcrom steel required only half the cobalt needed for steels made according to the various Japanese formulæ.

Extensive investigations have shown that the action of cobalt in raising the coercive force of steels is remarkably uniform, and within fairly wide limits can be very well represented by the equation

$$H_c = h \times (1 + k\,Co)$$

where h = the coercive force of the cobalt-free base, Co the percentage of cobalt present, and H_c the coercive force of the cobalt alloy. The constant k depends upon the base alloy to which the cobalt is added, and for properly hardened samples reaches a maximum value with from 9 per cent. to 14 per cent. of chromium, together with about 1 per cent. of carbon, and those steels in which for a given magnetic value the constant k in the formula just given is a maximum, are undoubtedly the most interesting to electrical engineers.

The Japanese steel, or K.S. magnet steel, owes its development to the generosity of Baron K. Sumitomo, who gave a considerable sum of money to Tokyo University for the investigation of alloy steels. The actual research work was carried out under the able direction of Professor Honda, and resulted in some remarkable steels being produced. It appears from the published data that numerous compositions were investigated, and a favourable range of composition for steels of this type is :—Carbon, .5 to .8 per cent. ; tungsten, 3 to 9 per cent. ; chromium, 1.5 to 3 per cent. ; and cobalt, 20 to 60 per cent. It is not essential that both tungsten and chromium should be present together, and useful alloys can be produced with either the one or the other absent.

Magnet steels of the cobaltcrom type are characterised by a high percentage of chromium, the preferred compositions falling within the limits chromium 9 to 15 per cent. ; cobalt from 1 to 18 per cent. ; and carbon above 1 per cent. In both the Japanese steels and the cobaltcrom steels, the cobalt content can be varied considerably to produce steels of different magnetic requirements, the optimum percentages giving coercive forces of the nature of from 200 to 250.

In the soft condition most cobalt magnet steels have a coercive force of the nature of 50 to 60, and the remanence varies from 9000 to 12,000 according to the exact composition and method of softening. It has hence been suggested that these steels might in some cases be used in the unhardened condition. Such a proceeding would not, however, be economical, and the inherent properties can only be properly utilised when the steels are in the hardened condition.

The hardening treatment for the two types of steel is very different. The Japanese steels require quenching in either oil or water according to composition, and even oil quenching at once signifies the provision of jigs for holding the magnets during quenching, and the usual dangers of cracking and distortion which go hand in hand with all quenching treatments.

Steels of the cobaltcrom type rely solely on air hardening, and hence do not give trouble during heat treatment in so far as cracking or distortion is concerned. The hardening temperatures vary considerably according to composition, and whatever type of steel is dealt with, it is essential that the temperature control shall be very efficient, and it is always necessary to work to within ± 10 deg. Cent. of the required temperature.

After hardening, alloys of either type possess, when fully magnetised, remarkable magnetic properties. The diagram—Fig. 1—shows a typical de-magnetisation loop of a modern cobalt magnet steel of either of the above types, together with a de-magnetisation loop of one of the best tungsten magnet steels.

MAGNETISATION.

In order to obtain the maximum efficiency from any magnet steel, it is necessary first to apply a magnetising force sufficiently great to saturate the steel. The old methods of single or double touch were never satisfactory, and electro-magnetic methods should always be used. In the case of bar magnets,

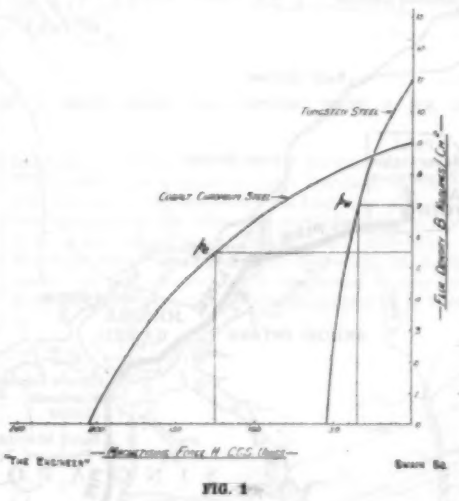


FIG. 1

it is usually most convenient to magnetise them in a solenoid ; this need not be as long as the magnet, as long as the latter is pulled right through the coil. In the case of horse-shoe magnets, or in cases in which it is desired to magnetise the magnets after assembling, an electro-magnet is necessary. A magnetising force of 500 C.G.S units is quite enough to saturate ordinary tungsten magnet steel, but the cobalt steels require a force of 1500 C.G.S. units, otherwise both remanence and coercive force will be low.

Before passing on to the influence of the high coercivity of cobalt magnet steels upon magnet design, it is necessary to refer briefly to the question of the criterion of magnetic quality. In 1913, when Dr. S. P. Thompson gave his paper, and, in fact, right up to the publication of Mr. S. Evershed's paper on "Permanent Magnets in Theory and Practice," it was not generally realised that neither remanence nor coercive force were true criteria of magnetic worth. It is now, however, recognised that the only criterion of magnetic quality, and at the same time the key to economic design, is the maximum available energy of the magnet per unit volume.

The study of permanent magnetism, is, generally speaking, very backward, and ignorance has done a lot to prevent the development of high coercive force steels. If the improvement of magnet steels had been one of increased remanence, no difficulty would have arisen, but the function of a high coercive force is not very well understood, the general view being that present-day tungsten magnets with a coercive force of about 65 are quite permanent enough. Such a view is quite untenable, because steels with a coercive force of 65 are only satisfactory because of their great length.

During the last few years Evershed and others have published a great deal of information concerning the design of magnets and the relationship between the size of a magnet for a given purpose and its magnetic properties. As a result of the work of these different investigators, it has been definitely established that the volume of magnet steel necessary for a given energy requirement is inversely proportional to the maximum available energy per cubic centimetre of that steel ; that the length of the magnet is inversely proportional to the magneto-motive force associated with the maximum available energy, and that the area of cross section is inversely proportional to the corresponding flux density. It follows that if economy of steel in a magnet is aimed at, the dimensions must be such that the product of the working flux density, multiplied by the value of the demagnetising force necessary to reduce the flux density from the remanence down to the working density, is a maximum. If a tungsten steel—the demagnetisation loop of which is shown in Fig. 1—is used, the magnet should be so proportioned that the working density corresponds as nearly as possible to the point p_w, while if the cobalt steel be used, the magnet should work at the point p_c.

The point p_w corresponds to B = 7000, H = 35

The point p_c corresponds to B = 5500, H = 125

Hence if a tungsten steel magnet has been so designed that it actually is working at or around the point p_w, then if its length be L and its area of cross section A, a cobalt steel magnet of length $\frac{35}{125}$ L and area of cross section . . . . . $\frac{7000}{5500}$ A will give the same output, the volume of tungsten steel and cobalt steel being

$$A\,L \text{ and } \frac{98}{275} A\,L \text{ respectively.}$$

Thus for any required output, a cobalt steel magnet with the properties indicated in the diagram would be less than half the weight of the necessary tungsten steel magnet, and as the improvement is one of increased magneto-motive force, the reduction is, as shown, brought about by reducing the length. It must be clearly understood that although a cobalt steel magnet can maintain the same energy as a good tungsten steel magnet of twice the weight, it does not follow that if a high coercivity steel is made the same size as an ordinary tungsten steel magnet, that it will give twice the flux ; as a matter of fact, it will sometimes give less owing to the dimensions not being suitable.

COBALT STEEL MAGNETS AND INSTRUMENT DESIGN.

The advent of high coercive force cobalt steels has given a new lease of life to permanent magnets, and their application has already led to numerous inprovements in the design of many instruments. The advantages to be derived from their use are various. Numerous instruments using circular magnets with consequent poles, short straight bar magnets, or small semi-circular magnets provide instances in which the greater flux maintained by a magnet with a high coercive force is well worth the extra expense of replacing an improperly proportioned tungsten magnet by a cobalt steel magnet of exactly the same shape and size. In other types of apparatus it is possible to replace the present tungsten steel magnets by cobalt steel magnets, which are so much lighter and simpler in shape, that in spite of the high cost of the cobalt steel per pound, the actual cost of the finished magnet is less. There are also many instances in which, whilst the actual cost of the magnets may be increased if cobalt steels are used, the instrument can be constructed more cheaply without in any way impairing its efficiency.

* Remanence is the residual magnetism left after a magnetising force sufficiently high to produce saturation has been applied and removed. Coercive force is measured by the inverse magnetising force required to destroy this residual magnetism. Both are usually measured in C.G.S. units.

Suggested New Water Supply for Singapore.

IT is general knowledge that Singapore is an island which was ceded to Great Britain by the Sultan of Johore in 1824. The water supply of Singapore Town, which lies to the south of the island, has hitherto been, and is at present obtained, from impounding reservoirs built within the island itself. The daily quantity of water available is 11 million gallons, and as the population supplied is 334,000, and the average consumption is 32 gallons per head, it will be realised that there is immediate necessity for seeking an additional source of supply. Indeed, the need has been evident to the municipality for some years past, but one of the difficulties in the way of meeting it has been that the local sources on the island itself are very nearly exhausted ; at any rate, they are incapable of adding sufficiently to the quantity of water at present available to meet the wants of the municipality for any length of time ahead.

Several schemes for obtaining additional supplies have been considered, among which may be mentioned those for obtaining water from :—

(*a*) A source known as the Pulai rivers.

(*b*) From a source known as the Pelepah.

(*c*) From the Lenggiu, a tributary of the Johore River.

(*d*) From the Skudai River.

(*e*) By development of the Seletar area on the island.

(*f*) By erecting dams across the estuaries of certain tidal rivers.

The Pulai scheme was prepared by the municipal

engineers, and it was eventually approved by the Commissioners. Before finally adopting it, however, it was decided, having regard to the facts that it would be costly to carry out, and that a Government loan would be required for the purpose, to take expert advice on the subject. The Crown Agents for the Colonies accordingly approached the firm of Sir Alexander Binnie, Son and Deacon, of Westminster, and it was arranged that Mr. Martin Deacon should go out to Singapore and make a thorough investigation on the spot. He has now returned and, through the courtesy of his firm, we are enabled to place before our readers the following information.

All the schemes mentioned above were investigated, and of them all the first—the Pulai scheme—was chosen for recommendation for reasons to which we shall refer later. Meanwhile, it may be said that the municipality was also advised to make careful records of the flow of the river Lenggiu, the reason being that in that river there is, in Mr. Deacon's belief, a flow sufficient to meet the whole of the requirements of Singapore for many years to come. It is true that pumping would be necessary, but, on the other hand, no large dam or impounding reservoir would be necessary, the supply being taken direct from the river.

Before passing on to consider the Pulai scheme in detail we may, perhaps, refer briefly to Mr. Deacon's conclusions with regard to the other proposals. As concerns the Pelepah, the position of which may be seen on the accompanying map, it is acknowledged that considerably more water could be obtained from it than from the Pulai rivers, but its adoption would involve the construction of a large dam, and every drop of water would have to be pumped to Singapore—a distance of 56 miles. To pump from the Pelepah source the 6½ million gallons per day—which is the volume that can be obtained by gravity from the Pulai works without any pumping at all—would, Mr. Deacon calculates, amount to no less than between £45,000 and £50,000 per annum. Then, as regards the Skudai River there is the objection that, though without doubt there is sufficient flow to enable a supply adequate to meet the needs of Singapore for many years to come to be obtained by pumping, the water is particularly dirty, and very large and expensive settling reservoirs would be required to clarify it before it could be passed on to the filters. Moreover, the nature of the ground is such that the cost of those reservoirs would be extremely heavy, so that on all counts the source cannot be considered as a serious rival of the Pulai scheme. One of the great advantages of the latter is that it can be proceeded with in sections. By laying the pipe line—which will be about 32 miles in length—it will be immediately possible to obtain a supply of 2½ million gallons of water per day without having to build any dam. The construction of a dam across the Pulai River will make available about another 3 to 4 million gallons per day. Then it is considered possible that, by erecting weirs across certain of the streams to the westward of the Pulai River, and by bringing the water thus derived by gravity to a pumping station, so that it might be lifted into a second reservoir formed by the construction of another dam, not far from the first, a further supply, the exact volume of which is not as yet accurately ascertained, but which would not be less than 5 million gallons, could be secured. This additional volume would, after being pumped into the reservoir, flow by gravity to Singapore. In all, therefore, the Pulai scheme will, it is estimated, possibly yield as much as 11 to 12 million gallons per day, and perhaps more, and it could be proceeded with bit by bit.

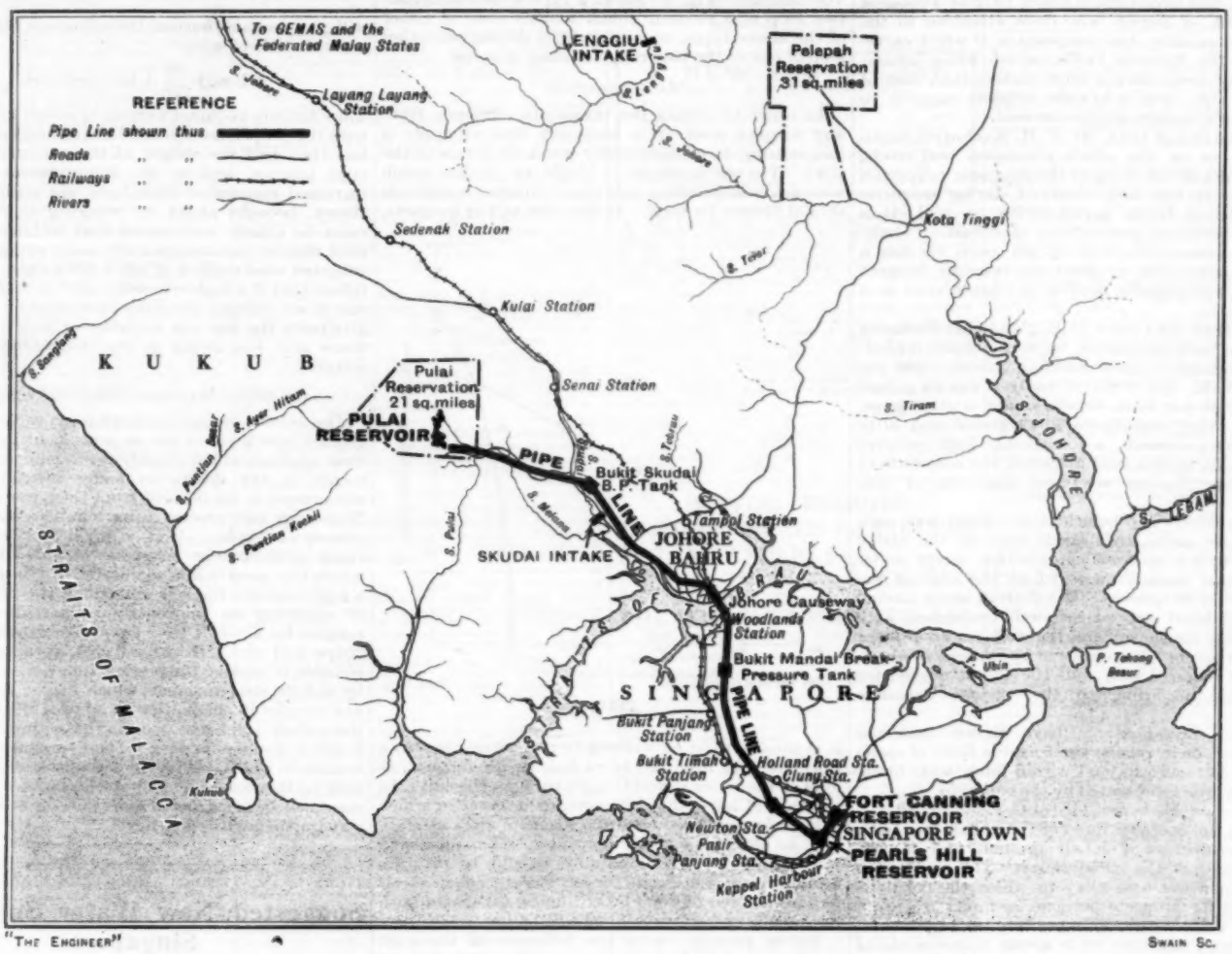
Without further information it cannot be said whether the valleys to the west of the Pulai River are suitable for the formation of reservoirs by means of dams. If they are, then a very much larger volume of water could be made available. Up to the present, however, it has been impossible to survey all the valleys sufficiently thoroughly to enable a definite decision to be come to on the matter. The matter of surveying is extraordinarily difficult and expensive by reason of the facts that the valleys are clothed with thick forests, and that the undergrowth is particularly dense. Survey parties must literally cut their way through every yard traversed. Sometimes the forest growth is so luxuriant that trees on the two banks of a stream interlock above it and are thickly bound together by creepers of enormous strength and thickness of vines and foliage. The result is that the work of surveying is slow and exceedingly laborious, and, furthermore, it is by no means without its dangers, for the bush is full of snakes and other poisonous reptiles and insects, including mosquitoes in vast quantities. Investigations will, however, be carried out in order to determine whether and, if so, which of the valleys can be satisfactorily dammed.

The soil throughout the district is for the most part disintegrated granite interspersed with huge granite boulders, some of them weighing 100 tons and more. In some cases curious depressions caused by erosion occur in the sides of a valley which, unless they too were dammed, would render that valley useless for forming a reservoir. So thick is the forest and undergrowth, however, that it is impossible to say whether such places exist in any particular valley until every yard of the watershed of the valley has been traversed, and, as a matter of fact, it is in many cases extremely difficult to ascertain where the watershed comes. Possibly aerial survey, such as is being used with success for similar purposes in the forest areas of Canada and the United States, would reveal the depressions; but, so far we understand, it has not been resorted to.

As the Pulai scheme had been most favoured by the municipal engineers, the ground in the neighbourhood of the site proposed for the first dam had been cleared fairly thoroughly. It was, therefore, possible for Mr. Deacon to examine it more closely than was the case with any of the other schemes. The three views on page 68 are reproduced from photographs taken from three different points. The engraving at the bottom represents a view taken at right angles to the proposed line of the dam, looking up stream. The two upper engravings show the banks of the valley on either side. Excavation work is in progress on the line of the dam, and the white patches in the upper views show some of the huge boulders of granite which have been uncovered. They are, of course, loose, and solid rock has not yet been encountered.

The water of the Pulai River is of great purity, and is exceedingly soft, but owing to the immense amount of sedimentary matter which is washed from the sides of the hills during heavy rainfalls, and which discolours the water, it will have to be filtered before it can be used for domestic purposes, the filtration being carried out before the water is sent down into the aqueduct. The Island of Singapore is separated from the mainland of the State of Johore by straits, which in their narrowest part are only some ¼ mile wide. It would have been possible, of course, to bring the water across to the island in pipes laid in the bed of the channel, as has been done in other parts of the world, notably at New York, but fortunately, what is known as the Johore Causeway—see THE ENGINEER, April 30th, 1920—is being constructed so that the pipe line can be run across it, and the necessity for designing special joints for the underwater portion will be avoided.

It may be added that Mr. Deacon recommended the original scheme, as worked out by the engineers of the municipality, after making considerable modifications and alterations. It is estimated that the first additional supply from Pulai could be made available by the year 1929, and that, in the meanwhile, the situation can be eased by obtaining another million gallons per day from Seletar on the island itself.



MAP SHOWING POSITION OF THE PULAI RESERVATION AND THE ROUTE TO BE TAKEN BY THE PIPE LINE TO SINGAPORE

THE prohibition of export coal by sea from British India is cancelled as from January 1st.

An Engineer's Sketch Book of the 18th Century.

By H. W. DICKINSON.

To the engineer of the present day, the illustrations that we present herewith will suggest the fancies of a Rackham or a Dulac as to what an engine might look like rather than what one actually did, yet had the illustrations appeared in our issue of one hundred and thirty years ago, supposing that THE ENGINEER had been in existence then, they would have represented up-to-date practice.

The views are taken from a sketch book which the Editor of THE ENGINEER found one day, while browsing in the library of Sir Gerald Chadwyck-Healey, at Wyphurst, Cranleigh. Struck with his find, he mentioned the fact to the writer, to whose mind the description recalled at once a book of engineering drawings which vanished in 1879, after having been sent up to London for examination. Of this book details were fortunately in existence and, on examination, identification proved to be complete.

The writer is thus able to give the history of the book, which is briefly as follows: It was got together by the industry of William Reynolds (b. 1758, d. 1803), of Ketley Ironworks, Shropshire, towards the close of the eighteenth century. This Reynolds was the son of Richard Reynolds, who married Abraham Darby's daughter. William Reynolds gave the book to his son-in-law, William Anstice, the grandson of whom, when clearing out an old office, handed it over to his clerk to do with as he liked. Fortunately, he took it to John Randall, of Madeley, well known in his day as a local historian and author, who recognised its value and published a description with some details as to its contents. In 1879, Mr. Randall sent the volume to someone in London under the impression that it was going to the South Kensington Museum.* What happened to it then is unknown, but it is assumed that it was purchased by Mr. Edward Healey, the founder of THE ENGINEER, and was taken by him to his house at Wyphurst, now owned by his grandson, where, as already related, it was found. Its sudden disappearance is at length explained.

Incidentally, Mr. Randall stated that he acquired at the same time and in the same manner, "30 vols. fol. MS. beautifully written and containing suggestions, inventions and drawings, but chiefly copies from the 'Transactions' of the Royal Society and others." These volumes were still in his possession in 1887, and it would be interesting to know, if still in existence, where they are now to be found.

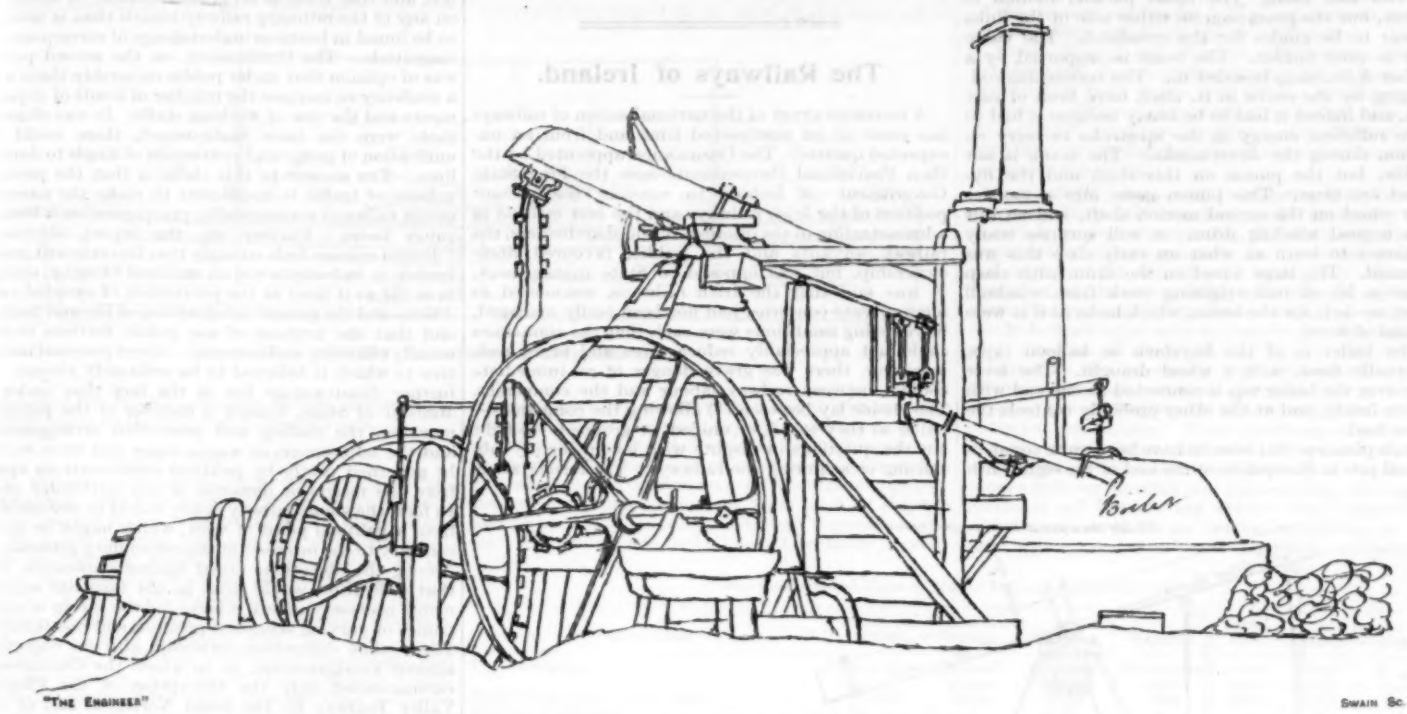


FIG. 1—SKETCH OF A BEAM ENGINE FOR WINDING FROM A PIT, DATE CIRCA 1790-1800

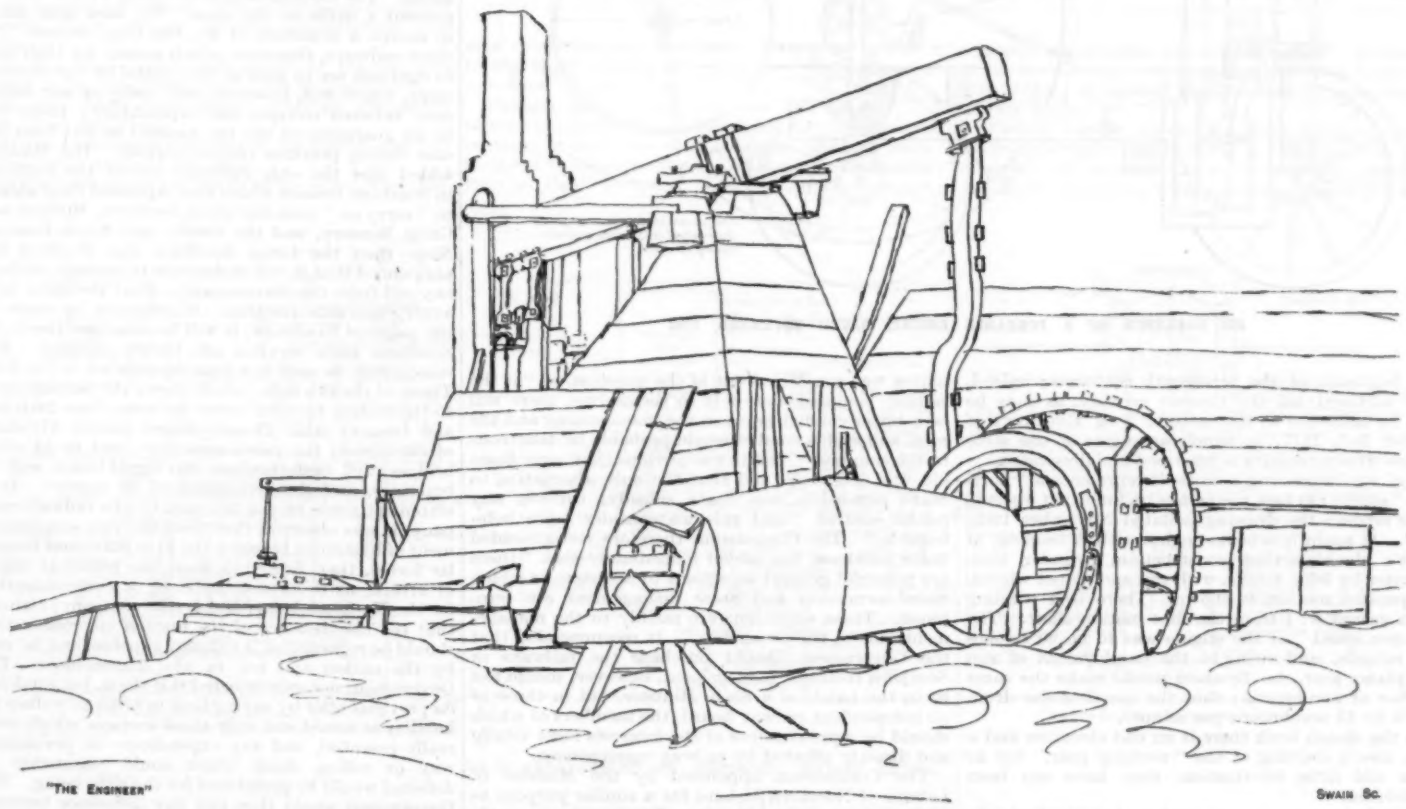


FIG. 2—SKETCH OF A BEAM ENGINE FOR WINDING FROM A PIT, DATE CIRCA 1790-1800

The sketch book contains upwards of 120 items, ranging over a wide field, embracing many designs of steam engines, especially those intended to give rotative motion for winding from pits; means for winning coal; plant for blast-furnaces; schemes for assisting in the excavation of canals; plans of canals, bridges and viaducts—in fact, all the engineering problems of the day, in which Reynolds was interested.

The execution of the items varies from beautifully finished drawings on Whatman paper to mere pen and ink or pencil sketches made on scraps of writing paper.

Perhaps we ought to say that there is nothing in the volume of capital importance, but we must be thankful for any light at all on this dark period of engineering history.

We are unable to find space for more than three

* Sir Gerald Chadwyck-Healey has now presented the book to the Science Museum, South Kensington; thus Mr. Randall's original intention will be carried into effect.—ED. THE E.

items out of the book, and these must be taken merely as samples.

Figs. 1 and 2 are two views of the same plant, *i.e.*, a beam engine for winding from a pit. Its date is within the last decade of the eighteenth century. The cylinder is not visible, but must have been of the Newcomen type, *i.e.*, open-topped and single acting. The piston-rod is connected with the beam by two side links. The usual parallel motion is absent, but the posts seen on either side of the links appear to be guides for the crosshead. The valve gear is quite hidden. The beam is supported by a timber A-framing, boarded in. The connecting-rod, judging by the curve in it, must have been of cast iron, and indeed it had to be heavy because it had to store sufficient energy in the up-stroke to carry on motion during the down-stroke. The crank is not visible, but the pinion on this shaft and the fly-wheel are clear. This pinion gears into a mortice spur wheel on the second motion shaft, and on this is a conical winding drum; it will surprise many engineers to learn at what an early date this was schemed. The large wheel on the drum with clasp arms—a bit of mill-wrighting work from windmill practice—acts for the brake, which looks as if it were a band of wood.

The boiler is of the haystack or balloon type, externally fired, with a wheel draught. The lever seen over the boiler top is connected at one end with a float inside, and at the other probably controls the boiler feed.

Such plants as this seem to have been quite common at coal pits in Shropshire at the end of the eighteenth

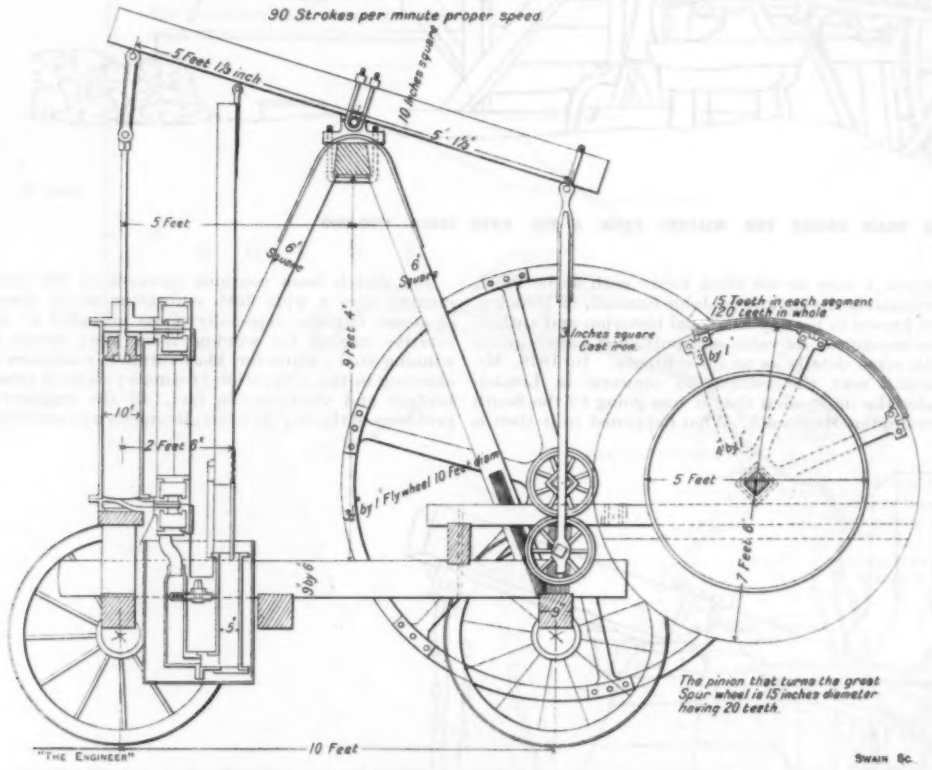


FIG. 3—SKETCH OF A PORTABLE ENGINE, DATED NOVEMBER, 1792

and beginning of the nineteenth centuries; indeed, they survived till the present century, as may be seen by reference to the issue of THE ENGINEER of August 3rd, 1917, in which an engine of the same general characteristics is described and illustrated.

Fig. 3 is interesting because it represents a "portable" engine; in fact, the first of its kind that we have come across; the drawing is dated November 19th, 1792. It again is a beam engine with A-framing, of Watt's double-acting construction, cylinder 10in. diameter by 36in. stroke, with sun and planet wheels. No parallel motion is shown. There is a winding drum geared 6 : 1 from the first motion shaft. The "proper speed" of the engine was to be 90 strokes per minute, and owing to the employment of sun and planet gear, the flywheel would make the same number of revolutions; thus the speed of the drum would be 15 revolutions per minute.

In the sketch book there is an end elevation and a plan, also a drawing of the "working gear," but as these add little information, they have not been reproduced.

The whole engine is mounted on four road wheels, 5ft. diameter, 10ft. wheel base and 9ft. track centres. The intention was to drag it by means of horses to the coal pit where winding was to be done and there couple up with a wagon boiler set in brickwork. It should be noted that the fly-wheel fouls one of the road wheel axles and would have to be taken off in order to travel and *vice versâ*. The engine part is Boulton and Watt's patented construction, and could not have been made without their aid. In the Boulton and Watt Collection at Birmingham there is a number of drawings of engines for Richard Reynolds and Co.,† and among them appear those of a colliery winding engine 10in. diameter by 3ft. stroke, 6 nominal horse-power. There is not much doubt, then, that the engine was made and supplied, but whether it was actually mounted in the portable form shown and used as described is open to a little doubt. It was some years later that such a portable engine is definitely known to have been made.

The Railways of Ireland.

A CONDEMNATION of the nationalisation of railways has come at an unexpected time and from an unexpected quarter. The Commission appointed by the then Provisional Government—now the Free State Government—of Ireland to consider the present position of the Irish railways and the best method of administration in the interests of the shareholders, the railway servants and the public, favoured State ownership, but was opposed to State management. It was said that the Irish railways, considered as mere private concerns, had not been badly managed, but existing conditions were such that the companies could not appreciably reduce rates and fares, and, moreover, there was grave danger of an immediate conflict between railway labour and the companies. The choice lay between (1) allowing the companies—either as they stood, or unified, or grouped—to fight out the questions in dispute with labour, or (2) subsidising or acquiring the railways. The former alternative was considered out of the question, as "if the railway companies are left to themselves, there will be a bitter conflict between the management and the men, and such a conflict would probably be disastrous to the country." But it was obvious that some State aid was necessary, and that the only alternative to State ownership was State subsidy, without any public control, "and this we consider quite indefensible." The Commission therefore recommended State purchase, but added immediately that "there are powerful general objections to a system in which State ownership and State management are combined. These objections are mainly to the management, not to the ownership." It recommended that the Government should purchase the railways in Southern Ireland. Management, however, should not be in the hands of a State Minister, but in those of an independent railway board, the members of which should be representative of the interests most vitally and directly affected by railway management.

The Commission appointed by the Minister of Labour of Northern Ireland for a similar purpose as to the railways in the Northern Territory has recently presented a report, in which State ownership and State management of railways are both emphatically condemned. This report—Cmd. 10, published by the Stationery Office, Belfast, price 1s.—contains a very valuable review of the history, physical features, financial position and earning powers of the eight railways situated wholly, and of the five railways partly, within Northern Ireland. The Commission considered three alternatives:—(1) Nationalisation, (2) unification, (3) amalgamation. The arguments for and against each of these alternatives are briefly submitted in the report, and the Commission then pronounces judgment on each. Nationalisation, it had been urged, would abolish the directorates and reduce the managerial staffs. The Commission replies that the directors' fees amount to only £5000 a year, practically a negligible proportion of the total wages bill, and that there is no greater number of directors on any of the ordinary railway boards than is usually to be found in business undertakings of corresponding magnitude. The Commission, on the second point, was of opinion that under public ownership there was a tendency to increase the number of heads of departments and the size of working staffs. It was claimed that, were the lines State-owned, there could be unification of gauge and conversion of single to double lines. The answer to this claim is that the present volume of traffic is insufficient to make the narrow-gauge railways commercially prosperous on a broad-gauge basis. Further on, the report observes: "Public opinion feels strongly that Government interference in industry is not an unmixed blessing, except in so far as it aims at the prevention of sweated conditions and the general safeguarding of life and health, and that the keynote of our public services is not usually efficiency and economy—direct personal incentive to which is believed to be ordinarily absent. A further disadvantage lies in the fact that under a Minister of State, himself a member of the political machine, the staffing and promotion arrangements and the adjustment of wages, rates and fares would be governed partly by political considerations apart from the merits or demerits of any particular case. In fact, the whole railway policy would be determined from a political point of view, which might be quite contrary to the interests of the community generally." Among the objections urged against unification was that difficulties would arise in the financial adjustments necessary in any scheme for the fusion of companies of varying economic position and possibilities. These same difficulties furnished also an objection against amalgamation, as to which the Commission recommended only the absorption of the Clogher Valley Railway by the Great Northern, and of the Ballycastle Railway by the Northern Counties Committee of the Midland Railway.

We cannot leave this subject without referring to the serious state of affairs in which the railways in the Free State find themselves. The terrible unrest there has led to there being very little travel, and in a long statement made by the Minister of Industry and Commerce on the 3rd inst., it was said that every railway was either bankrupt or on the verge of bankruptcy. The railway companies, in view of this condition, proposed to reduce each man's wages by 3s. 6d. per week, whereon the men threatened to strike. The Government intervened, with a view to prevent a strike at this time. The men were asked to accept a reduction of 2s., but they refused. All those railways, therefore, which cannot see their way to continue are to pass to the control by the Government, which will, however, only make up any deficiency between receipts and expenditure; there will be no guarantee of the net receipts as has been the case during previous control periods. The Minister added that the only railways out of the forty-six in Southern Ireland which had expressed their ability to "carry on" were the Great Northern, Midland and Great Western, and the Dublin and South-Eastern. Since then the Great Southern and Western has announced that it will endeavour to manage without any aid from the Government. That company is in a very grievous position. If reference be made to the pages of Bradshaw, it will be seen that the Great Southern train services are hardly existent. The reason may be seen in a map reproduced in the *Irish Times* of the 6th inst., which shows the damage done to the system by rebel forces between June 28th last and January 5th. These outrages include 375 cases of damage to the permanent way, and to 51 overbridges, 207 underbridges, 83 signal-boxes and 13 buildings, and the derailment of 42 engines. In a statement made on the 5th inst. by the railway company, it was observed that from the very commencement of hostilities between the Free State and Irregular forces, that line had been the principal object of attack, as it formed the lines of communication for the National Army, and it (the company) claimed that the maintenance of the lines of communication should be regarded as a military expense, and be met by the nation and not by the shareholders. The Government not only rejected this claim, but qualified its previous offer by saying that in order to reduce its liability it would run only those services which were really essential, and any expenditure on permanent way or rolling stock which could reasonably be deferred would be prohibited for the time being. The Government would then pay any difference between receipts and expenses which the resources of the company were not themselves able to meet. The company thereupon announced that it would endeavour to continue unaided.

† Portfolio 31.

THE Cologne International Fair will be opened in May, 1923. The industries principally represented will be those of the Rhenish-Westphalian districts, the most productive centre of Germany. The iron and steel trades, machinery makers, and the weaving industry will all exhibit.

A Review of Marine Diesel Engines.*

WITH the object of stimulating discussion on the various types of motor ship machinery which are now built in British yards, the North-East Coast Institution of Engineers and Shipbuilders recently invited contributions to a review of different types of marine internal combustion engines. The papers submitted were read on Friday last, and further discussion is to take place on the evening of the 26th inst.

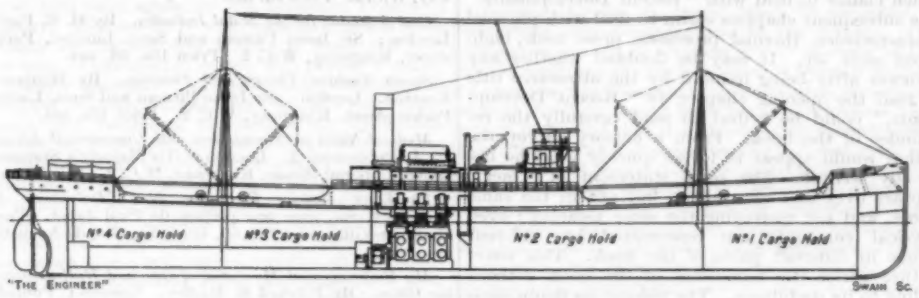


FIG. 1—DOXFORD MACHINERY IN SPECIFIED HULL

THE SPECIFICATION.

A uniform ship specification was issued by the Institution, and also a speed power curve showing the estimated brake horse-power for a ship's speed of 10¾ knots on trial, with the best propellers available at different revolutions. The outline of the cargo ship specified is shown in the drawing reproduced in Fig. 1. The following are principal dimensions:—Length overall, 371ft.; breadth moulded, 50ft. 9in.; depth moulded, 28ft; draught, 23ft.; displacement, 9220 tons; estimated deadweight and carrying capacity, 6570 tons. The minimum length of engine-room, 40ft. 4½in., is more than sufficient to obtain the 32 per cent. deduction from the gross tonnage. The proposals submitted provide for a steam boiler of sufficient capacity to provide steam for the operation of the following auxiliary machinery. One steam windlass, 9½in. by 12in.; nine steam winches, 7in. by 10in.; one steam winch, 7in. by 12in.; one 18-kilowatt lighting set and steam heating for the accommodation. At sea only the lighting set and steam heating will probably be required, and the surplus steam should be available for the steam steering gear—8½in. by 8½in.—and other engine auxiliaries. An alternative scheme, with electrically-operated auxiliaries, driven by Diesel-electric generators, may be submitted. The information embodied in each of the reviews includes the following particulars:—

(1) The total brake horse-power of the engines, stating under what conditions it can be maintained.

(2) The brake horse-power overload obtainable above trial conditions.

(3) The mechanical efficiency of the engine, and the method of arriving at the same.

(4) Fuel consumed per brake horse-power when the ship is steaming at the designed speed of 10¾ knots. (*a*) For main engines only; (*b*) for all purposes.

(5) The type of fuel assumed and its calorific value; what fuels are recommended for continuous running, and whether the engines would operate satisfactorily on the heavier boiler oils for a continuous period.

(6) The total weight of the main propelling engines and auxiliaries in the engine-room.

(7) Cost per ton-mile.

* Synopsis of papers read before the North-East Coast Institution of Engineers and Shipbuilders, January 12th, 1923.

In the table appended we reproduce some of the more important figures returned by the different firms contributing to the review.

Sir W. G. Armstrong, Whitworth and Co., Limited, put forward two proposals with Armstrong-Sulzer Diesel engines, namely, with steam-driven auxiliaries and also electrical auxiliaries. In the first scheme a steam turbine driven scavenging-blower supply the scavenging air, but in the second scheme the scavenging pump is arranged on the main engine, to avoid the necessity of fitting a high-speed motor driven scavenge blower; it is stated that at present there is a difficulty in obtaining high-speed electric motors in this country. With regard to the heavier fuels, the engine is said to run satisfactorily on boiler oils for a continuous period, provided that not more than 3 per cent. of sulphur and 15 per cent. of asphaltum content is present in the oil. The use of such fuel oil would probably necessitate more frequent overhauls. Attention is drawn to the small number of valves and the consequent reduction in spare gear.

Palmers Shipbuilding and Iron Co., Limited, and Cammell Laird and Co., Limited, put forward a scheme representative of the class of engine which is manufactured by John Brown and Co., Limited, Clydebank; Smiths' Dock Company, Limited, Middlesborough; David Rowan and Co., Limited, Glasgow; and Dunmuir and Jackson, Limited, Glasgow. Particulars are given of runs made on Mexican boiler fuel oil and heavy Borneo oil. A saving in weight of over 70 tons is affected, as compared with similar steam engine machinery. Electrical auxiliaries are put forward, and the size of the engine allows a neat arrangement of engine-room. With higher piston speed the weight of machinery could be reduced.

William Doxford and Sons, Limited, submit two arrangements of a three-cylinder engine, which is shown in elevation in Fig. 1, with steam and electric auxiliaries respectively. A mechanical efficiency of 82 per cent. has been attained on test bed trials, and 85 to 86 per cent. with the Heenan and Froude water brake. Boiler oils can be used satisfactorily and continuously, but attention is called to wear resulting from hard particles of ash which some of the heavier oils undoubtedly contain. Fuel consumptions and costs are given in detail, and also sizes and capacities of the various auxiliaries. The engine-room staff is given as three engineers and three greasers.

Swan, Hunter and Wigham Richardson, Limited, put forward the Neptune marine oil engine, and schemes for both steam and electric auxiliaries are outlined. Although the engine will run quite well on boiler oil, attention is called to the effect of hard asphalt in producing deposits in the cylinders, entailing extra attention.

Scott's Shipbuilding and Engineering Co., Limited, propose a Scott-Still installation, the machinery plan of which we reproduce in Fig. 2. Solid injection is employed, and arrangements are made for running the engine, both ahead and astern, on oil. The operation of the steam inlet and exhaust valves is controlled by gear-driven distributors. A pump of the Hele-Shaw type, with automatic variable delivery gear, supplies oil at 400 lb. per square inch, to the distributors for operating the steam valves. An 80 brake horse-power steam turbine driven blower supplies the scavenging air at a normal rate of 7000 cubic feet per minute. The regenerator or boiler has a steam generating surface of 1150 square feet, and is designed to raise steam at a pressure of 150 lb. per square inch for starting and manœuvring the engine. Auxiliary oil burners are fitted. The engine-room complement is given as twelve, consisting of the chief engineer and three watch engineers, one stand-by engineer, six greasers and one storeman. A feature of the installation is the small engine-room length of 31ft. 10½in., as against the standard drawing length of 48ft. 10½in.

Vickers Limited submit a scheme which is stated to be a compromise between a low fuel cost and economy of running. A continuous sea speed of 10½ knots is assured, with a mean indicated pressure of 96 lb. per square inch, and a mechanical efficiency of 78 per cent. A feature of the proposal is that the donkey boiler is designed for utilising the heat of the exhaust gases. The engine-room staff recommended is a chief engineer and three assistants, three greasers, one donkey man, and a storekeeper.

R. and W. Hawthorn, Leslie and Co., Limited, put forward a Werkspoor marine engine having a maximum output of 2000 brake horse-power at 95 revolutions per minute. Under normal conditions the engine would operate at a slightly lower output, and

A Review of Different Types of Marine Internal Combustion Engines.

Particulars.	Armstrong-Sulzer.	Camellaird-Fullagar.	Doxford.	Neptune.	Scott-Still.	Vickers.	Workspoor.
Type of engine	Two-cycle	Opposed-piston	Opposed-piston	Two-stroke cycle	Two-cycle	Four-cycle	Four-cycle
Brake horse-power, main engine	1840	1828	1850	1840	1870	1760	1848
Number of cylinders	4	4	3	4	4	6	6
Cylinder bore	26.77in. (680 mm.)	24in.	21.25in. (540 mm.)	26in.	25in.	28in.	29.9in. (760 mm.)
Stroke of piston	47.24in. (1200 mm.)	36in.	42.5in. (1080 mm.)	56in.	45in.	45in.	55.12in. (1400 mm.)
Revolutions per minute	92	85	96	90	106	112	95
Overload, per cent.	10 to 18	25	23	10–25	35	—	10
Overall mechanical efficiency	73 to 75	73	82	73	88	78	73
Fuel consumption, lb. per B.H.P. hour	0.386	0.39	0.40	0.43	—	0.42	0.41
Total fuel consumption, main engine and auxiliaries, lb. per B.H.P. hour	0.512	0.410	0.410–0.450	0.45–0.48	0.370	0.43	0.45
Calorific value of fuel, B.Th.U. per lb.	18,000	19,000	18,000	18,500	18,000	18,000	17,800
Cost in pence per ton-mile with steam auxiliaries	0.0061	—	0.0057	—	0.0040	0.0067	—
Cost with electrical auxiliaries	0.0054	0.0040	0.0053	—	—	—	0.0053
Total weight of machinery with steam auxiliaries	405	—	430	430	375	460	—
Weight with electrical auxiliaries	414	430	450	430	—	—	350–550
Assumed cost of fuel oil (Diesel oil) per ton	—	80s.	87s. 6d.	—	77s. 6d.	92s. 6d.	80s.

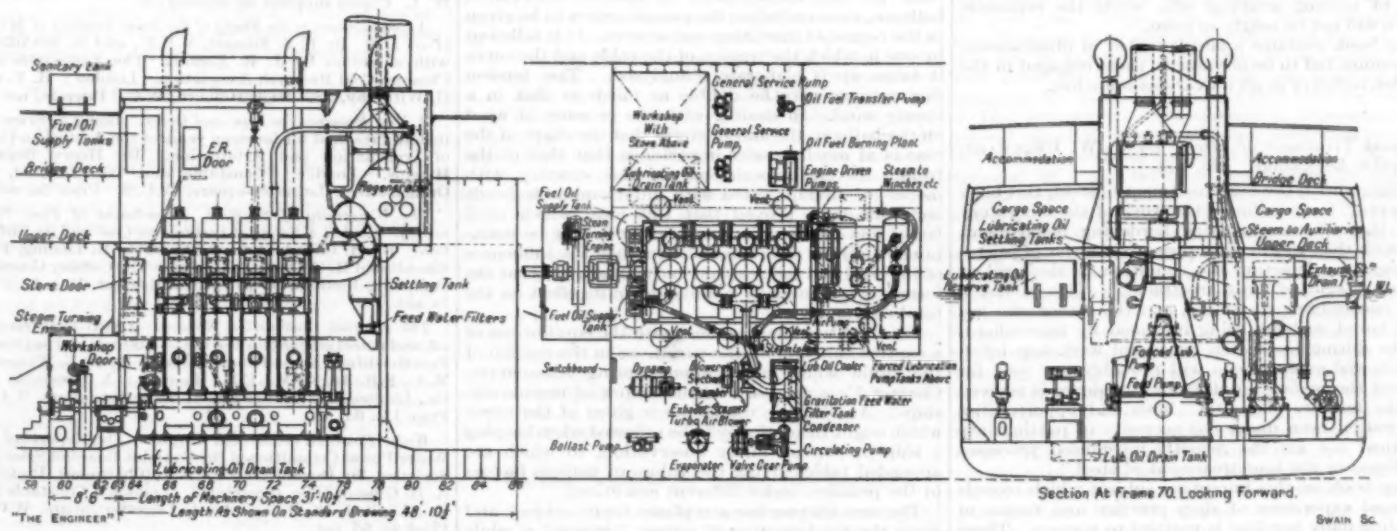


FIG. 2—ARRANGEMENT OF SCOTT-STILL MARINE ENGINE

a mean indicated pressure of 90 lb. per square inch is assumed. The auxiliary machinery proposed is electrically driven, a small 80 square foot Cochran boiler serving for heating purposes. The engine-room staff proposed comprises eleven members, and includes four engineers, one electrican, and six assistants.

Literature.

Woollen and Worsted Spinning. By ALFRED F. BARKER, M.Sc. London: Cassell and Co., Limited. 12s. 6d. net.

IN the preface to this publication it is explained that the volume is the second of the two specially designed to take the place of a little work upon the same subject written by Mr. W. S. Bright McLaren in 1884. Although it contains some three hundred or more pages, it is only claimed to give a broad survey of the ground covered. The woollen industry, much like that of cotton, has been largely evolved by practical men, and the author has attempted fairly successfully to bring practice within the limits of scientific methods. The book appeals almost entirely to those engaged in the woollen and worsted industry, but it will also be read with interest by a large section of engineers in Lancashire and Yorkshire on account of the many ingenious appliances which are described and illustrated. There are in all fifteen chapters headed as follows:—Raw Materials; Carding and Condensing; Woollen Yarn Spinning; Frame Spinning—Twisting and Winding; Sets of Woollen Machines; the Basic Principles involved in Worsted Drawing; Worsted Drawing Machine; Worsted Spinning; Coloured Yarn Production; Twisting Theories; Testing of Wool, &c.

In the chapter on raw materials, the author describes the difference between woollen and worsted yarns broadly as one of fibre arrangement, the former being based upon the free and perfect mixing up of all the fibres composing the thread, while the worsted yarn is based upon the parallelising and constraining into a direction parallel with the length of the thread of all the fibres composing it. A second differentiation between the two classes of yarn is that of length of fibres. Although this differentiation is broadly true, the length of fibres used in the manufacture of worsted yarns is now very much shorter than it was formerly. Nevertheless, the woollen spinner usually deals with short fibres and the worsted spinner with relatively long fibres. Most readers of the book will not require to be told that cotton plays a prominent part in woollen manufacture. Originally cotton was introduced into the manufacture of woollens to prevent shrinkage, but to-day cotton is employed as a binding material for short wool and re-manufactured wool from waste fibres, helping to carry the latter through the carding process, thus producing better wearing properties. Similarly, waste flax, hemp and jute are made use of to mix with the pure wool for the sake of cheapness—a process which frequently accounts for the harshness which some woollen goods present to the touch. The author considers it quite likely that an artificial fibre approximating to wool can also be produced, and anticipates that in the near future a much nearer approximation may be attained, although the problem in all its phases is much more difficult than that of making artificial silk, while the economic return will not be nearly so great.

The book contains a large number of illustrations, and cannot fail to be of value to those engaged in the woollen industry in all its various branches.

Thermal Treatment of Steel. By J. W. URQUHART. Crosby Lockwood. 35s. net.

IN dealing with the heat-treatment of steel, this book attempts "to co-ordinate the work of the laboratory with that of an engineers' hardening department, and with that end in view presents a series of micro-photographs depicting the condition of the steel at various stages of heat treatment." This is not a very encouraging statement, and the reader who has been bored without being informed by microphotographs during his search for useful workshop information and explanations will probably not read far beyond the preface; unless his confidence is revived by the authors claim to "have had opportunities and indeed been under the necessity of putting into practical use all the recently introduced processes employed in the heat-treatment of steel."

Any book on this important subject which records personal experience of shop practice and means of avoiding daily troubles is entitled to respect. Those books illustrated with microphotographs, which may represent equally well good or bad steel and bad or good tools, are neither interesting nor useful; they are attempting the impossible, as the general relationship they are seeking does not exist. The workshop would welcome methods of investigation which have been developed in the laboratory if they, in some simpler form, could be used to good effect in the workshop. The most competent microscopist can rarely tell anything new and useful about the quality of a tool from the appearance of microphotographic prints; and he knows generally just what the shop description of the tool has told him. By patient exploration with a high power microscope of the best tool made, it is possible to find photographic evidence to incriminate always the steelmaker and sometimes the hardener; a very inferior tool may, on the contrary, be given excellent credentials. As the microscopist is generally wise after the event, why not say so and thus help in diverting to its legitimate use a valuable branch of laboratory work which, through unearned respect, threatens to dominate with priestly authority the art of tool hardening.

The book comprises fourteen chapters, the first of which claims to deal with "Recent Developments." The subsequent chapters claim to deal with physical characteristics, thermal processes, press tools, high-speed steel, &c. It may be doubted whether any reviewer after being induced by the attractive title to read the opening chapter on "Recent Developments," could be bribed to read carefully the remainder of the book. From a cursory survey the author would appear to forget quickly what he has already written. The same statement of "fact" appears over and over again, but not in the same words, and not conveying the same meaning; even physical constants are represented by different figures in different parts of the book. This novel feature varies the monotony of the book without adding to its usefulness. The volume no doubt aims at being useful, but it rarely reaches its mark. Yet one would like to encourage the author as he is probably better at hardening tools than at writing books. The pity of it is that he should regard, with awed respect, microscopes and thermo-couples, which he does not understand, and try to express in terms of them his knowledge of shop practice which may really be first-class. As a result his book is not interesting to those who have knowledge and experience, and it is confusing if not actually dangerous to those who may select it as a guide.

The most unfriendly comment which could be made on Mr. Urquhart's book would be to fill a column with extracts and leave it at that. There is, however, good stuff in it, and the following quotations are made merely to illustrate the kind of troubles encountered by a man on stilts who might go very well afoot. The chapter on "Recent Developments" says:—"The microstructure under the lens exposes to the experienced steel man the nature and quality of the steel. Upon seeing a fractured surface a steel treatment man might say I can see this steel is only in the troostitic state. Sorbite has been considered by several distinguished metallurgists to be identified with the amorphous substance which fills the space between the crystals of hardened steel. It might be reasonably supposed that a half-hardness might be produced—on hardening—but no half-measures are acceptable to the law of chemical change—it shall be pearlite or it shall be wholly cementite."

The book concludes with a chapter on "Stainless Steel," which appears to be almost a verbatim reprint of a trade pamphlet. A few paragraphs only have been added, and they contain information which would be very mildly described as "unreliable."

Etude sur le Ballon captif et les Aéronefs marine. Par le Commandant CHARLES LAFON. Paris: Gauthier-Villars et Cie. 1922.

THE first chapter of this book contains detailed instructions for the management of marine observation balloons, even including the precise orders to be given in the course of executing manœuvres. It is followed by one in which the tension of the cable and the curve it takes up is elaborately analysed. The tension during gusts may be double as much as that in a steady wind. In dealing with the pressure of wind on the balloon, the author states that the shape of the rear is of much greater importance that that of the front. Recent experiments in this country with models of airships fitted with interchangeable heads and tails have proved that this idea, which until lately was the accepted one, can no longer be maintained. These tests have shown that the influences of the head and tail react on one another, but that the former is undoubtedly paramount in its effect on the total resistance.

The next two chapters deal with the equilibrium of a captive balloon and the variations in the tension of the cable which come about during manœuvres. Chapter V. is an essay on the tactics of marine airships. An abstruse discussion is given of the curve which ought theoretically to be followed when keeping a ship or convoy under observation, to which are appended tables giving the values of various factors in the problem under different conditions.

The next chapter has aeroplanes for its subject, and gives the mathematics of certain "stunts"; while the last consists of the application of various equations and methods which have previously been set out, suitably modified, to ships—a process which gives solutions for problems such as the distance in which a ship stops when the engines are reversed, the distance required to bring about a given change of speed, &c.—concluding with equations and tables giving the precise speed and course required to perform certain evolutions in company with other vessels.

Finally, there is some advice to young officers, who are told that they cannot master any subject until they have plumbed it to the bottom, by "*un travail acharné.*"

The book can be recommended to students of aviation, and the last chapter will be of interest to navigating officers, but in both cases they must be fairly handy with French and with mathematics.

BOOKS RECEIVED.

Gasworks Recorders. By Leonard Levy. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 35s. net.

Oxy-acetylene Welding. Air Publication 880. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 9d. net.

Cost Accounts for the Metal Industry. By H. E. Parkes. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

Steam Turbine Theory and Practice. By William J. Kearton. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 15s. net.

Medical Notes in Connection with Commercial Aircraft. C. A. Publication 3. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 9d. net.

La Force Motrice Electrique dans l'Industrie. Par Eugène Marec, avec une préface de Paul Janet. Paris: Gauthier-Villars and Cie, 55, Quai des Grands-Augustins. Price 55f.

My Railways and Me: Six of One and Half-a-dozen of the Other. By Edward S. Hadley. London: Published by the Great Western Railway, General Manager's Office, Paddington Station, W. 2.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1921. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 2s. net.

Reports of the Light Alloys Sub-committee of the Advisory Committee for Aeronautics, June, 1921. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 18s. 6d. net.

The Nitrogen Industry. By J. R. Partington, M.B.E., D.Sc., and L. H. Parker, M.A., D.Sc., F.I.C. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 21s. net.

Essais de Soudures Autogène et Electrique de Pièces de Chaudières. By E. Hoehn, Society Suisse de l'Acétylène. Paris: Librarie Polytechnique Ch. Béranger, 15, Rue des Saints-Pères 15. Price 4f. Français.

Fourteenth Annual Report of the Hydro-electric Power Commission of the Province of Ontario for the year ending October 31st, 1921. Printed by order of the Legislative Assembly of Ontario. Toronto: Clarkson W. James.

Whittaker's Mechanical Engineer's Pocket Book. Edited by W. Erskine Dommett. Third edition, entirely re-written. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 12s. 6d. net.

Mastering Power Production: The Industrial, Economic and Social Problems Involved and Their Solution. By Walter N. Polakow. London: Cecil Palmer, Oakley House, Bloomsbury-street, W.C. 1. Price 30s. net.

The Association of Engineering and Shipbuilding Draughtsmen. The Elements of Diesel Engine Design. By D. Bruce. London: Published by the Association, 98, St. George's-square, S.W. 1. Copies on application to the secretary.

Marine Works: A Practical Treatise for Maritime Engineers, Landowners and Public Authorities. By Ernest Latham, with a preface by C. Le Maistre, C.B.E. London: Crosby Lockwood and Son, Stationers' Hall-court, Ludgate-hill, E.C. Price 16s. net.

Shall the State Throw away the Keys? An exposition of what fine chemicals mean to the nation. With a foreword by Sir Wm. J. Pope, K.B.E., F.R.S. London: Association of British Chemical Manufacturers, 166, Piccadilly, W. 1. Copies supplied on application.

A Contribution to the Study of the Stone Dusting of Mines. (Part II.). By F. S. Sinnatt, M.B.E., and A. McCulloch, with a section by J. R. Lomax. The Lancashire and Cheshire Coal Research Association. London: H. F. and G. Witherby, 326, High Holborn, W.C. Price 2s. net.

A New Province for Law and Order. Being a review by its late President for fourteen years of the Australian Court of Conciliation and Arbitration. By Henry Bournes Higgins. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 5s. net.

The University of Sheffield, Department of Fuel Technology. Coal: A Series of Lectures on Coal and its Utilisation. By H. Chamberlain, J. W. Cobb, R. Lessing, F. S. Sinnatt and M. C. Stopes. London: The Colliery Guardian Company, Limited, 30–31, Furnival-street, E.C. 4. Price 5s. net.

The Internal Combustion Engine. A text-book on gas, oil, and petrol engines for the use of students and engineers. Fourth edition, revised and enlarged. By H. E. Wimperis, M.A., F.R. Ae. S., M.I.E.E. London: A. Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 12s. 6d. net.

Water Power in the British Empire. The Reports of the Water Power Committee of the Conjoint Board of Scientific Societies, Sir Dugald Clerk, F.R.S. (Chairman), Professor A. H. Gibson, D.Sc. (Secretary). London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 3s. 6d. net.

Department of Scientific and Industrial Research. Food Investigation Board. Special Report No. 9, by the Engineering Committee of the Board: The Transmission of Heat by Radiation and Convection. Experiments by Ezer Griffiths and A. H. Davis. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 1s. 6d. net.

Aircraft Steels and Material. By Brig.-General R. K. Bagnall-Wild, C.M.G., C.B.E., Leslie Aitchison, D.Met., B.Sc., A.I.C., A. A. Remington, O.B.E., M.I. Mech. E., M.I.A.E., A. J. Rowledge, W. A. Thain, A.M. Inst. C.E., with an introduction by Professor W. Ripper, C.H., D.Eng., D.Sc., M. Inst. C.E. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 16s. net.

A Seven-Day Journal.

A Chance for British Iron and Steel.

THE familiar fact that political events have generally their industrial corollaries is likely to be proved true once again by the action of France in Germany. France, as is well known, depends upon Germany for the supplies of coke to smelt the Lorraine ores. Germany, it seems, will pursue a policy of "passive resistance" to the French demands, and the supply of coke will fail with—as the French ironmasters are beginning to foresee—an immediate reduction in the output of French iron. In Germany the disturbances in the Ruhr at Essen and at Bochum cannot fail to cause diminution or even cessation of production. Thus both countries will reduce their pressure upon the markets of the world, and other iron-producing countries—of which, naturally, our own comes first in our thoughts—will be offered opportunities for development which they will not be slow to seize. Whatever happens, it seems probable that the effect of the present French action will continue for at least six months, and if the British iron trade does not benefit thereby it will have no one but itself to blame. It is already evident that the British coal industry is to have the chance of accepting large orders from Germany, while a report is to hand from Sheffield that a Rotherham firm has already received an order for £100,000 worth of railway wheels and axles for India, which order would almost certainly have gone to Germany but for the French occupation of the Ruhr.

Fire Detection at Sea.

ACCORDING to Lloyd's returns fire is the only sea casualty which is on the increase. More than 65 per cent. of ship fires start below the superstructure, and of these 72 per cent. originate in the inaccessible cargo compartments. Once a fire has been detected and located, any extinguishing medium, such as high-pressure steam, carbon dioxide, inert flue gases or chemical extinguishers, are useful, especially in the early stages, but immediate detection is of supreme importance. Since in closed spaces aboard ship smoke precedes fire by hours and often by days, it is not surprising that smoke detection is the line of development followed in designing the most recent fire-fighting appliances. In the Rich system, which has been largely developed in America, and is represented here by the Sperry Gyroscope Company, a smoke detector cabinet is fitted in the wheel-house, and is connected by small pipes to each compartment of the ship. Air is continually drawn through the tubes by a small fan in the detector. Each tube terminates in a vertical funnel through which a strong beam of light is projected. The light is normally invisible, but should the air in any tube contain the smallest trace of smoke a white cone of light flashes into view. The air from the pipes may be passed into the wheel-house, so that the sense of smell may aid that of sight. The apparatus is stated to be so sensitive that the smoking of a cigarette in a distant hold can easily be discovered. The detector pipes are combined with the fire-smothering system in such a manner that the air pipes are closed when the fire-extinguishing medium is in operation.

Trans-Humber Communication.

FOR over forty years means of improving communication between Hull and North Lincolnshire have been extensively debated, but so far the problem would appear to be as far off solution as ever. The Humber at this point is about two miles wide, and at present all heavy goods for transhipment have to be carried by way of Goole, about 22 miles further up, where the river is crossed by a railway bridge. The idea of constructing a railway tunnel below the Humber at Hull for goods and passenger traffic has recently been revived; but in view of the Government's refusal to assist the scheme on the grounds that it would not be profitable, that it would take a long time to carry out, and that it was not of great national urgency, the proposal would appear once more to have fallen through. For the same reasons a proposed scheme for a bridge across the river was denied the aid of the Unemployment Grants Committee. The President of the Board of Trade, Sir Philip Lloyd-Greame, has suggested that a train ferry system might overcome the difficulty, but against this scheme it is urged that the river is too shallow, and in places is too encumbered by sand banks to permit the running of anything but shallow-draught ferry boats. Opinion seems generally in favour of a tunnel, failing which a bridge on the up-river side of Hull would be preferred.

The Therm Inquiry.

THE fourth meeting of the Board of Trade Committee on the therm as a measure for charging for gas was held in London on Tuesday. Mr. Cash, a director of several gas companies, disagreed with a contention advanced by the Croydon Corporation to the effect that an increase in the thermal value of the gas supplied did not lead to a decrease in the number of cubic feet consumed. Mr. Herring, on behalf of the Ilford Council, said that twenty years ago the calorific value of gas supplies was nearly 600 B.Th.U. per cubic foot, whereas to-day 450 was a common figure. In many cases, he remarked, a low value was advantageous to the public. The ignorance—to use no stronger word—of many of the public regarding the physical basis of the new method of charging was illustrated by one witness, who stated that in Sunbury a very large number of meters were out of order and that it was commonly believed that the trouble was "due to the therm," and that the gas, "being of greater heat, was affecting the meters." Mr. Brown, of Southall, a consulting municipal engineer, raised the question of impervious road surfaces and gas escapes, but was informed that the subject, while of very considerable importance, was a matter for the attention of a Parliamentary Committee. Mr. Butterfield, one of the Gas Referees, stated that there was no evidence to show that there was any appreciable decrease in the quality of the gas between the works and the consumers' meters. Sir Dugald Clerk strongly supported the therm, and said that its introduction had already opened a wide field for the gas engineer. Mr. George Helps, manager of the Nuneaton Gas Company, created some liveliness by remarking that every consumer in the country was paying twice, and in some cases three times, as much for his gas as he need. He supported a low calorific value and the regulation of pressure at the nipple of each burner.

British Turbines for America.

WE are informed that the Commonwealth Edison Company, of Chicago, in order to gain experience of the latest developments in steam turbine practice in this country, has placed an order with C. A. Parsons and Co., of Newcastle-on-Tyne, for a 40,000-kilowatt turbo-alternator. The 25,000-kilowatt turbo-alternator which the Commonwealth Edison Company ordered from Messrs. Parsons in 1912 for its Fisk-street station continues, we learn, to run satisfactorily. The set which has just been ordered is to be installed in the new Crawford-avenue power station at Chicago, of which the designed capacity will be about 500,000 kilowatts, the rest of the plant being probably mainly of American manufacture. The consulting engineers are Messrs. Sargent and Lundy, Chicago, and Merz and McLellan, London. Turbo-alternators, of 40,000-kilowatt capacity, it may be recalled, are already at work at the Gennevilliers station in France. These sets have Zoelly turbines, which were made in France. Turbo-alternators of 50,000-kilowatt capacity were proposed for the super-power stations in the Coal Conservation Committee's report in 1917.

A Clyde Shipyard to Reopen.

THE shipyard at Whiteinch known as the River Clyde Shipbuilding Works, originally owned by John Reid and Co., has been purchased by the Australasian United Steam Navigation Company, Limited—a company of which Lord Inchcape is chairman and managing director—and, it is expected, will shortly be re-opened under the management of one of the shipbuilding firms on the upper reaches. The yard was unoccupied for a period of years, but during the war it was taken over by the Lloyd Royal Belge Company, of Antwerp, which, under the title of the Lloyd Royal Belge (Great Britain), Limited, used it for the construction of vessels for its own services. Between 1917 and 1920 over a dozen cargo steamers were built at the yard for the Belgian company. In January, 1921, however, the establishment was closed down because of the high costs of construction, combined with the additional expenses introduced by the rate of exchange between this country and Belgium. Four cargo steamers were left on the stocks, and on them and on their machinery then under construction in a Glasgow marine engineering shop work has since been suspended. It is expected that the new owners will resume operations on the vessels, one of which is partly framed, a second is ready for plating, and the third and fourth have their keels laid.

A Ballast Separating Barge for Tankers.

CONSEQUENT upon the coming into operation on the 1st of this month of the Oil in Navigable Waters Act, 1922, under which it is now an offence to discharge oil or allow it to escape into the sea within the three-mile limit, much attention has been directed towards the provision of means whereby tankers and other vessels carrying oil may discharge ballast from their oil tanks without offending against the Act and without proceeding to sea. A system of this description has been worked out and recently put through satisfactory trials by Smith's Dock Company, of South Shields, in conjunction with the Anglo-Saxon Petroleum Company. A 250-ton barge is used for the reception of the oily ballast water from the ship. The barge is divided by transverse bulkheads into a series of compartments, the first compartment being equipped with cone separators and baffles and the others with cascade filters. The chief portion of the separation is performed in the first compartment, the completion being effected by the cascade filters. From 180 tons to 200 tons of ballast water can be dealt with by the barge per hour. The system has been tested in connection with the oil tanker Corbis. Two of the tanks, holding a total of 3200 tons of ballast water, were pumped out in a total working time of 17 h. 25 min., or at the rate of 183.9 tons per hour. We understand that the discharge from the barge showed no signs whatever of oil, and that some 60 tons of oil were retained in the barge. Two of the barges, it is stated, have been placed on order by the Port of London Authority.

The National Boiler Insurance Company.

ON Tuesday the shareholders of the National Boiler and General Insurance Company, meeting in Manchester, decided to accept an offer made to them by the Alliance Assurance Company for the purchase of their shares at a cash price of 50s. per share. The directors had agreed to sell their own shares and to recommend the shareholders to sell theirs. That recommendation was adopted, and the directors were authorised to carry into effect the provisional agreement which they had entered into with the Alliance Company.

The Norton and Gregory Engineering Scholarships.

IT is announced that Norton and Gregory, Limited, mathematical instrument makers, of London, have arranged to offer two annual engineering scholarships, one valued at £100 per annum and the other at £50, each tenable for three years at any approved British or Imperial University. Candidates must be between seventeen and nineteen years of age on the first day of March in the year of examination, and will be required, if successful, to satisfy the committee controlling the award of the scholarships that their financial resources are insufficient without assistance to enable them to pursue the intended course of study. Selection of the successful candidates will be based on the results of a two-days' examination in English, mathematics, mechanics and general physics, and upon a final oral examination in London. Included on the honorary committee in charge of the scheme are Sir Joseph Petavel (chairman), Professor C. E. Inglis, Professor E. G. Coker, and the chairman and managing director of Norton and Gregory. Further particulars and entry forms may be obtained from the Secretary, Scholarships Committee, Norton and Gregory, Limited, 1 and 2, Castle-lane, S.W. 1.

Sixty Years Ago.

IN a paper on "Steam Boiler Explosions," read by Mr. Nursey before the Society of Engineers and reprinted in our issue of January 16th, 1863, a revelation is to be found regarding the state of boiler construction and operation in those days. We read that "during the past year" more than thirty boiler explosions were recorded, each attended with loss of life—in one case six, in another no less than twenty-eight lives were sacrificed. A warm tribute was paid by the author to Mr. Zerah Colburn—at that time the editor of THE ENGINEER—whose efforts to determine the general cause of boiler explosions, according to Mr. Nursey, had not been surpassed by anyone. He had disposed of "the favourite hypotheses of superheated steam, electricity, explosive gases, spheroidal water, over-pressure, and water freed from air," and had established the fact that violent explosions of steam boilers were mainly due "to the combined percussion of the steam and water leaping up on the sudden removal of the steam previously resting on the surface of the water." In a note headed "Aluminium Bronze" the wonders of a new alloy composed of 10 per cent. aluminium and 90 per cent. copper were recorded. The price of the alloy is given as 6s. 6d. per pound, or four to five times that then current for gun-metal. An extract reprinted from *Galignani's Messenger* contained a very severe criticism of Professor William Thomson's (Lord Kelvin's) theory regarding the age of the earth as calculated from the rate at which it was cooling. The criticism turned upon the fact that, in comparison with the earth's radius, our knowledge of how the temperature increased with the approach to the centre was confined to a depth of utterly insignificant amount. In our correspondence columns we notice a letter complaining of the steam and sulphurous vapours in the tunnels of the London Underground Railway—opened during the previous week—and suggesting the adoption of the atmospheric system as used on the old South Devon line. Another correspondent, we observe, sought guidance as to where he might obtain an intelligible account of the new mechanical theory of heat, about which Mr. Joule and Professor Rankine had recently had so much to say. A third correspondent, Mr. Henry Dircks, wrote on the subject of "liquid steam" as a cause of boiler explosions.

A Transatlantic Wireless Telephony Test.

To many who have read the recent accounts of amateurs in this country having received music and speech from the wireless broadcasting stations in America, it may appear that Transatlantic wireless telephony is quite a simple and straightforward affair, and that the establishment of a commercial service presents little, if any, difficulty. But reference to the report which was issued a little while back by the Radio Research Board will show that the experts who were examined in connection with the inquiry with which the report dealt were of opinion, at that time at any rate, that radio communication on a commercial basis over a distance of 3000 miles or more was somewhat remote. There is, of course, a vast difference between the occasional reception of signals by amateurs and an efficient and reliable commercial service. During the winter nights it is possible to receive in England radio telephonic messages from low-power short-wave stations in America, but during the daytime and the whole of the twenty-four hours in the summer the strength of the signals received from these American stations is extremely small as compared with the electrical disturbances which are always present, and reception becomes impossible. To ensure reliable reception, it is essential to use much longer wave lengths and a much greater amount of power than is employed by the broadcasting stations. Still, as we pointed out when dealing with the Radio Research Board's report, progress in radio-telephony has been very rapid during the last few years, and it will be strange if all difficulties are not shortly overcome.

One of the most remarkable experiments in wireless telephony was made in 1915, when the American Telegraph and Telephone Company carried out some long-distance tests with thermionic valves. Using the United States Navy aerial at Arlington, Virginia, messages were transmitted during September and October in 1915 to Paris, Honolulu and to Darien, the maximum distance being 5000 miles. But these experiments did not indicate that long-distance wireless telephony was commercially possible, for although speech was received at Paris, Honolulu and Darien, the reception was not good enough for commercial purposes, notwithstanding that the power employed at Arlington was about ten times greater than that used in the broadcasting stations at the present time. For these experiments a large number of small transmitting valves were connected in parallel, and the experimental equipment was, naturally, costly. Developments in the manufacture of thermionic valves have, however, greatly altered the position. It is now possible to manufacture relatively high-power valves which will generate continuous waves for wireless telephony under more economical and altogether better conditions than in the past, although it still remains to be shown whether wireless telephonic communication between this country and America can be carried out on a commercial scale.

Since the introduction of these relatively high-power valves, commercial radio telephony over great distances has become a more attractive scheme than it was in the days when continuous waves could only be generated by a relatively large number of small valves or by an arc generator or high-frequency alternator, and especially in view of the fact that the radio system is the only one that is practicable for transmitting speech across the Atlantic and Pacific oceans.

The American Telephone and Telegraph Company and the Radio Corporation of America have carried out much experimental work with a view to investigating the feasibility of commercial Transatlantic radio telephony. For this purpose, radio telephone transmitting apparatus has been installed at Rocky Point, Long Island, and is connected by telephone lines to New York, which is 70 miles away. It is possible to connect the wireless transmitting equipment through ordinary telephone switchboards to any point in the United States, so as to enable any subscriber on the Bell telephone system to communicate with Europe *viâ* Rocky Point, in exactly the same way as when he carries on an ordinary telephone conversation. As no corresponding transmission equipment has so far been installed in England, it has only been possible to transmit speech from America to this country, but judging from the results that are being obtained, there is every possibility of a transmitting station being erected in this country before very long.

Tests carried out between the New Southgate works of the International Western Electric Company and 195, Broadway, New York, between the hours of 2 a.m. and 4 a.m. on Monday last, demonstrated pretty clearly to those who were present that long-distance radio telephony is rapidly advancing from the purely experimental stage. Sharp at 2 a.m.—the hour appointed for the demonstration to begin—messages were received on head telephones by about sixty visitors, and apart from a little interference, mainly from atmospherics—which are, of course, the chief troubles on such transmissions—the reception left little to be desired. "This," said Mr. H. B. Thayer, at the beginning of the demonstration, "is the American Telephone and Telegraph Company, speaking from 195, Broadway, New York City, and transmitting over telephone wires to Rocky Point, Long Island, where the Radio Corporation of America are sending it off." Mr. Thayer then gave a brief description of the steps which had led up to this achievement, and expressed the hope that wireless telephony would bring England and America closer together in the bonds of friendship. The messages were replied to from this side by cable, and were answered over the radio telephone within a few minutes, one of the cable messages sent through reaching its destination within a period of one minute. With short intervals for announcements from Mr. F. Gill, who presided over the demonstration and for taking refreshments, this form of communication was kept up perfectly satisfactorily until 4 a.m. in the morning, thus showing the wonderful advance that has been made in the transmission of speech by means of electro-magnetic waves. Of course, it is to be remembered that the test was carried out in the winter and during the night, when conditions for radio communication are most favourable.

In the summer, when disturbances are considerably greater, the test would, of course, involve the use of much greater power at the transmitting end. It is interesting to note that between January 1st of this year, when the New Southgate receiving equipment was installed, and January 15th, 1923, a signal to noise ratio of 10 or greater was maintained every day for fourteen hours, *i.e.*, between 11 p.m. and 1 p.m. (Greenwich time), and fairly good telephone speech could be heard at any time between those hours, provided near-by stations were not working in the frequency range used, *i.e.*, about 56,000 to 59,000 cycles per second. In all electrical communication systems, irrespective of whether wires are used or not, the noise tends to make the signal unintelligible, and if this noise, measured in the same units as the received signal is nearly equal to or is greater than, the signal, no amount of amplication will make the signal distinct. For good and reliable communications, the strength of the received signal must be approximately twenty times that of the noise, the limit of transmission range being set entirely by the allowable signal disturbance ratio. When designing a transmission system, therefore, the first matter to be settled is the strength of the signal produced by a given amount of transmission power, and, secondly, the disturbance to be expected at the receiver during different times of the day as well as during every day throughout the year, and having determined these two factors, it is a simple matter to arrive at the amount of power required for transmission at any moment.

Field strength and electrical disturbance measurements—due to continuous wave interference and "static"—are essential in this connection, and the work of making the measurements in America is now complete, but in this country similar investigations have only recently been begun, and they will not be completed before the end of the year. Having acquired this information, it will be possible to determine the cost of a radio Transatlantic wireless telephone system for giving communication in both directions, and the way in which the cost varies with the quality of the service. The band of frequencies employed in the transmission should be as small as possible, for low-frequency bands suitable for long-distance transmission are valuable. Moreover, as a very fair amount of power is required for long-distance radio telephony, the efficiency of the plant should be as high as possible, and on account of the difference in the electrical disturbances during winter and summer, the transmitter output should be flexible, the power being capable of variation from, say, 100 to 1000 kilowatts. The minimum frequency range may be secured, and is secured by transmitting only one side band of the complete modulated wave, which incidentally also reduces the power required for transmission to one-third of that needed when transmission is carried out in the ordinary way. Every component frequency of a modulating voice wave is represented in the corresponding modulated carrier wave by two components. These are known as the upper and lower side bands, and since speech can be transmitted by one side band alone, there is no necessity for transmitting them both. Selective circuits are accordingly arranged to transmit only one side band. This system is now employed in the carrier wave telephone system of the American Telephone and Telegraph Company and its associated companies, and is described in a paper read by Messrs. Colpitts and Blackwell before the American Institute of Electrical Engineers, and published in the Institute's *Journal* for April, May and June, 1921. The transmitter used in the tests carried out on January 15th is composed of a number of valves—shown in Figs. 1, 2 and 3. The single side band is selected at low power and amplified by means of these water-cooled power tubes up to about 60 kilowatts, and then radiated from the aerial, this power, it is said, being equivalent to more than 200 kilowatts of a complete modulated wave transmitted in the usual manner. The transmitter is able to supply 200 kilowatts to the aerial, which is 450ft. high.

At the receiving end, New Southgate, in the case of the tests carried out on December 15th, the missing carrier frequency component is introduced into the receiving circuit by means of a local oscillating valve, when reception and amplification are carried out in the usual way. In all, eight valves were used at New Southgate last Monday, including the local oscillating valve, and the signals were received on a 6ft. frame aerial.

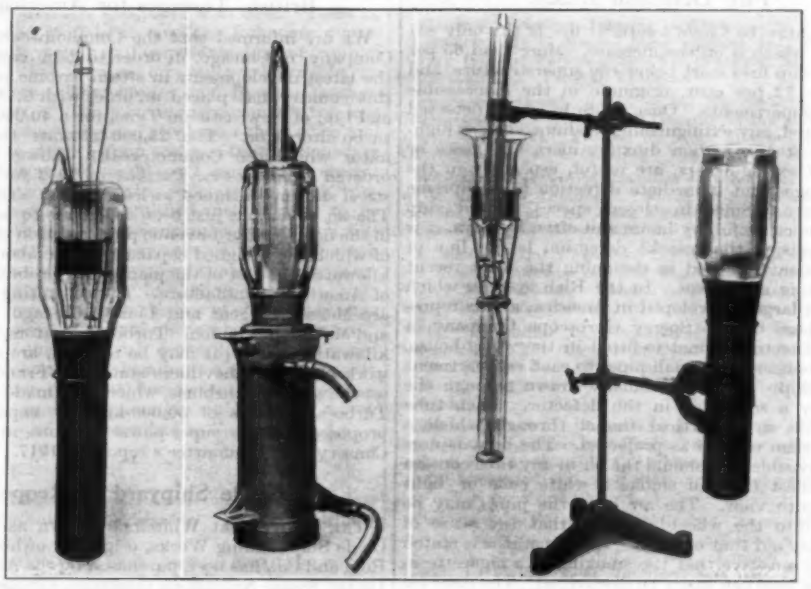


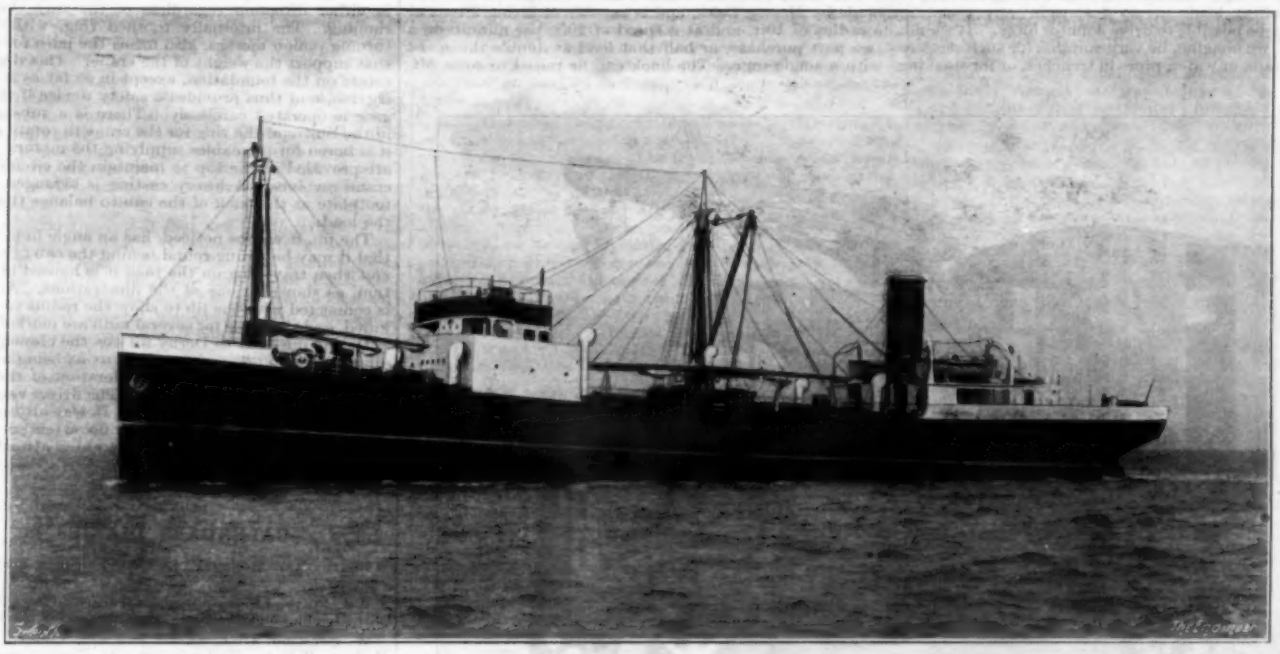
FIG. 1 FIG. 2 FIG. 3

The valves at the transmitting station are of the same type as those recently exhibited by Mr. F. Gill at a recent meeting of the Institution of Electrical Engineers, and as shown in Figs. 1, 2 and 3. Their capacity is 10 kilowatts. Rectifier valves of this type have only two electrodes, whilst oscillator and amplifier valves have, of course, three electrodes, the grid in the rectifying valves being omitted. A special feature of the valves is a water-cooled anode, which consists of a copper tube which is fixed into the glass bulb by means of a special copper glass seal, the joint being perfectly gas-tight, and is unaffected by the heating and cooling which occurs during manufacture and operation. When in service, the valves are mounted so that the anode is surrounded by a metal jacket—as shown in Fig. 2—and through this jacket the circulating water passes. The characteristics of these 10-kilowatt valves are as follows:—Normal filament current, 24.5 ampères; normal filament voltage, 32 volts; normal plate voltage, 10,000 volts; power taken by valve, including internal losses, 15 kilowatts; output power delivered from tube, 10 kilowatts.

In addressing the members of the Railway Students' Association of the London School of Economics on "Intensive Traffic Working," Mr. H. E. O. Wheeler, of the South-Eastern and Chatham Railway, said that the scheduling of every detail of the working of each engine, carriage and train last Derby Day led to twenty-four special trains being "on time," and fifty-two averaging 1.94 min. late, the worst being 7 min. late arrival. In 1920 there were fifty-four trains, and their average late arrival was 18.1 min.

MOTOR SHIP PIZARRO ON HER TRIAL TRIP

WILLIAM BEARDMORE AND CO., LIMITED, DALMUIR, BUILDERS



The Sea Trial of the Motor Ship Pizarro.

ECONOMY is the keynote of modern progress, and in no direction is this more so than in the case of that great fleet of merchant ships on which the every-day life of the British people so largely depends. Another step in the direction of progress and economy was reached at the beginning of this year, when the motor ship Pizarro completed a highly successful acceptance trial before being handed over to her owners.

The Pizarro is a sister ship of the Pinzon, described and illustrated in THE ENGINEER of February 10th last year, and was built at Dalmuir, to the order of Messrs. MacAndrews, of London and Liverpool. These ships are steadily justifying the far-sighted policy of their owners in ordering Diesel-driven tonnage.

The Pizarro, like her sister ship the Pinzon, is a single screw ship fitted with an engine of the Beardmore-Tosi type, designed to develop 1200 brake horse-power at 120 revolutions per minute. The dimensions of the vessel are:—Length between perpendiculars, 240ft.; breadth moulded, 38ft.; depth moulded, 18ft.; deadweight capacity, 2000 tons. The official trials were run in the Firth of Clyde on January 8th of this year, when the photograph we reproduce above was taken. The results of the trial were of a very satisfactory nature, the contract speed of 10½ knots being easily and substantially exceeded. The following particulars give the main points of interest extracted from the records obtained during the run from the Cloch to Cumbrae Lights and back:—Mean sea speed, 12 knots; mean speed, revolutions per minute, 123.25; mean brake horse-power, 1390; temperature of sea inlet to engine, 45 deg. Fah.; temperature of cooling outlet from engine, 115 deg. Fah.; piston cooling water outlets, 99 deg. Fah.; temperature of exhaust gases, 600 deg. Fah.

One of the most outstanding features of the Beardmore-Tosi engine is the patented valve gear. The valves in this engine alternate from inlet to exhaust by means of a director valve, and thus work at only half the speed of the valve gear in the ordinary Diesel engine. This arrangement gives a very silent operating valve and reversing gear, and also goes far to eliminate the routine changing and grinding in of exhaust valves as experienced with most four-cycle Diesel engines.

No boilers are installed in the vessel, and all heating and cargo working is done electrically, the power being obtained from Diesel-driven auxiliary generators. The general comfort of the ship and the efficiency of the electric heater system was remarked upon. The fuel consumption at sea for all purposes works out under 5 tons per day, or about one-quarter that of a coal-fired steamer of the same size and equal speed. In addition to the runs over the measured mile at Skelmorlie, the usual manœuvring, reversal and astern running trials were also carried out to the requirements and satisfaction of the representatives of Lloyd's Registry. The trial was attended by a representative gathering of officials from shipowning and shipbuilding concerns, and from the impression we gained it would seem that the barrier of secrecy which has so long hedged in the Diesel engine industry is being rapidly broken down. Most builders now realise that they have nothing to loose, and everything to gain by throwing their productions open to the inspection of really interested people.

We learn that the Dalmuir works have recently booked an order for twin-screw machinery of the "Beardmore-Tosi" type to be installed in an 11,000-tons cargo vessel. This vessel will be constructed by the Blythswood Shipbuilding Company, Limited, and as with the Pinzon and Pizarro, no steam will be used on board, all auxiliaries being electrically driven.

Extensions at the Stoke-on-Trent Electricity Works.

IN our issue of April 7th of last year we published a short article on some extensions in the central power-house of the Stoke-on-Trent electricity supply undertaking. The original scheme for the Stoke district, it may be remembered, comprised a central power-house supplying power at 6600 volts to four existing power stations, where it is converted into low-voltage alternating or direct current for supplying the needs of the existing networks. The extensions at the central power-house, which we previously described, have naturally involved extensions being made to the other stations, and on Thursday, January 18th, these extensions were formally put into operation.

A third motor generator set has been installed in the Hanley station, for converting the three-phase, 6600-volt, 50-period current into single-phase 2200-volt, 100-period current required in the Hanley area. The three-phase switchgear was installed in an existing cubicle in the central power-house, and is practically similar to that existing. The single-phase switchgear is in this case installed in the old Hanley station, and an existing single-phase equipment was modified, so as to be suitable for the new machine. The motor circuit is fitted with the Merz-Price circulating current system of protection.

Extensive alterations have been made at the Burslem station, a turbo-alternator having been installed as well as additional converting plant, and several new 6600-volt feeders have also been added to meet the demand of consumers requiring a bulk supply at this voltage. The 6600-volt switchgear has consequently been greatly extended, and changes have been made to the existing switchgear to meet the new conditions. A set of moulded stone cubicles equipped with the latest design of oil circuit breakers has been built for the new circuits. These cubicles are fitted with duplicate bus-bars to provide a flexible switching system. The existing cubicles were modified to accommodate the duplicate bus-bar arrangement, and these line up with the new set. The additional control panels have been arranged to be similar in appearance to the original panels, so that a uniform appearance is given to the control board. Special protective devices have been fitted on new circuits to ensure continuity of supply on the rest of the system, should a feeder or machine circuit become faulty.

A similar series of extensions to those at Burslem have been carried out at Stoke. In this sub-station, however, the switchgear changes were more drastic. It was found necessary to pull down and rebuild the existing cubicles in a different position, in order to obtain the space required for the new switchgear. Advantage was taken of this necessity to build all the cubicles required to the same design and at the same time. The change-over and re-arranging of the existing circuits were completed without any interruption of the supply. The cubicles are constructed of moulded stone, which is carried in a wrought iron framework. Duplicate bus-bars are provided, and the oil circuit breakers are of modern design, having a large arc-rupturing capacity. The control panels are in line with those previously existing, and form an extension to the board. Special large synchronising instruments, which are visible from any part of the control board, have been installed to facilitate synchronising. As at Burslem, special protective devices have been installed on the generator and feeder circuits.

The extensions at the Longton sub-station have not been so extensive as those which have been carried out at the other stations. Two additional rotary converters have been installed, and the necessary switch cubicles and panels have been arranged to form extensions to the existing structures. The arrangement is similar to that of the previously existing equipments, but a modern type of circuit breaker has been supplied.

During the past few years, supply in bulk at 6600 volts has been required by various large firms and surrounding districts. Most of these consumers are supplied from the central power-house, but a few are supplied from the 6600-volt bus-bars in the main sub-stations. These consumers' sub-stations have been supplied with switchgear designed to secure the safety of the operator, as it is likely that the majority will be operated by semi-skilled or unskilled men. Most of these switchboards are of the truck type, and are fitted with hand-operated circuit breakers. All the apparatus requiring attention is mounted on a movable truck which can be wheeled away so that the adjustments can be made with ease and in safety. When the truck is in position, all "live" parts are enclosed, and interlocks prevent the circuit being made or broken on the plug contacts.

Devices to limit the area of disturbance in the case of machine or feeder breakdowns have been installed on new circuits and on some of those previously existing. The system protects the machine and disconnects it from the bars in case of an internal fault, and when used in conjunction with an automatic field switch, its instantaneous operation prevents much damage to the machine. It has been found, in cases of machines protected by this system, that repairs required have been very small, and the machine has only been out of commission for a very short period. Two protective systems have been fitted to the main feeders, the Merz-Price balanced voltage system and the split conductor system. The principle is the same in both cases. Under normal conditions, the currents flowing into and out of a circuit are the same, and can therefore be balanced against each other, but any difference between the two, due to an intermediate fault, can be made to operate a relay and disconnect the faulty circuit from the network. The split conductor system utilises the balancing principle in a different manner. The main conductor is divided equally, so that the main current in each portion of the conductor is the same. The two currents are then balanced against each other. This system is more sensitive than the balanced voltage arrangements, and avoids the use of a pilot cable, but requires a special form of main cable and circuit breaker. Both systems are unaffected by faults or overloads outside the protected area. Hence, in order to prevent damage by heavy currents when a fault occurs just outside the area, say, on the sub-station bus-bars, all feeders are fitted with overload inverse time limit relays of the induction pattern. Both the time and overload settings are adjustable, and they are designed so that the more the overload exceeds the relay setting, the shorter is the time of operation of the relay.

NOTES FROM CANADA.

THE Provincial Government of Quebec has awarded a contract to the Quebec Development Company for the construction of a large dam at the outlet from Lake St. John, the head waters of the Sagenay River, for the development of 200,000 horse-power of electrical energy. The cost is estimated at 12,000,000 dols., and the work, which will occupy two or three years, will be begun as soon as possible. Premier Taschereau, of Quebec, announces that this undertaking is the first part of a larger project for the ultimate development of 1,000,000 horse-power.

The necessary permit having been secured from the United States Government, the Niagara River Bridge Company and the Michigan Central Railroad Company will construct a new steel arch bridge to replace the present cantilever bridge over the river between the cities of Niagara Falls, Ont., and Niagara Falls, N.Y. The contract has been awarded to the American Bridge Company, of Philadelphin, and the cost, according to engineers' estimates, will be about 2,000,000 dols. The new bridge will have a 640ft. span, and will be a double-track railway bridge.

A Petrol-Electric Road Crane.

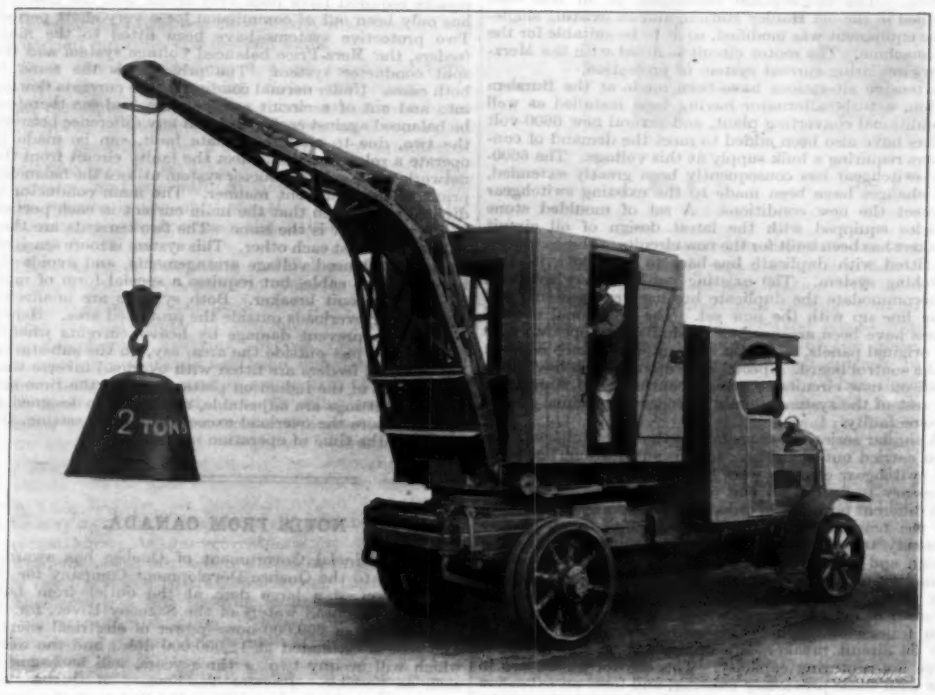
WE recently inspected at the works of Henry J. Coles, Limited, Derby, the rather novel crane shown in the accompanying engravings. It has been evolved with the idea of rapidly handling loads up to 2 tons in any situation where it may be possible to drive a motor lorry. It would, for instance, we imagine, be very suitable for such services as placing drain, or water, pipes in trenches, or for stacking goods in a stockyard. It is not intended, primarily, that the crane should travel with the load hanging on the hook, although such a manœuvre is permissible within moderation; but if a load has to be moved any distance, it may be dropped on to a trailer and then towed to its destination by the crane. The reason for this limitation is the fact that the lorry does not provide a firm enough base for the crane until a solid connection has been made between the frame and back axle, so as to relieve the back springs of load. This connection is made by means of links that are pivoted to the frame, and can be swung over the axle by screw gear at the back of the chassis. The arrangement is, in fact, similar to that used in connection with the London fire escapes.

2-TON PETROL-ELECTRIC ROAD CRANE

The chassis on which the crane is mounted is the standard heavy type of 4-ton Tilling-Stevens petrol-electric lorry, and is so well known as to need no description. The framing has been shortened somewhat at the rear, but otherwise the chassis is normal. There is, however, a slight addition to the engine. It has been found ample for the purposes of operating the crane to run the engine at only half speed, so an extra throttle has been added in the inlet from the carburetter. This throttle is controlled by a solenoid in the electrical circuit, and keeps the engine speed down to such an extent that the voltage does not exceed about half that ordinarily used for propelling the lorry.

The crane itself is of the standard single-motor type made by Messrs. Coles, and is capable of lifting 2 tons at a radius of 10ft. and at a speed of 20ft. per minute on a two part purchase, or half that load at double the speed with a single rope. The hook can be raised to some 8ft. from the ground. The crane can be rotated about a complete circle.

All the movements of the crane are effected by a 4 horse-power, series-wound motor, by the General Electric Company, which takes current at 110 volts from the main dynamo of the chassis. The motor is equipped with the usual type of drum controller, and a special switch is fitted for automatically tripping the main cut-out if any attempt is made to luff the jib too far in or out. There is a solenoid brake on the motor spindle and a train of reducing gears for driving the main shaft. For the lifting motion a pinion on this shaft can be made to slide in or out of gear with the toothed wheel on the barrel. The barrel, by the way, is large enough to hold all the hoisting rope in one lap. There is a brake on the barrel, operated by a foot pedal, besides the electro-magnetic brake, which is capable of sustaining the full load. The luffing, or derricking, motion, for varying the outreach of the jib, is operated by bevel gear and a worm and worm wheel which drive a small drum at the level of the footplate. This worm gear has a ball-bearing thrust and a special brake to prevent the jib running down. The makers claim that this is a more satisfactory arrangement than the common scheme of using a plain thrust collar and trusting to its friction for holding the jib. The luffing tackle is a three-part purchase, and is made fast at the angle of the jib. The revolving gear is driven from the main shaft by friction gear, and will turn the crane in either direction regardless of the way the motor is running. The internally toothed ring, with which the turning pinion meshes, also forms the path for the rollers that support the weight of the crane. This ring is free to rotate on the foundation, except in so far as it is held by friction, and thus provides a safety device if the rotating gear is operated carelessly. There is a substantial post in the centre of the ring for the crane to rotate about, and it is bored for the cables supplying the motor. Slip rings are provided at the top to maintain the circuit while the crane revolves. A heavy casting is arranged under the footplate at the back of the cab to balance the weight of the load.



PETROL-ELECTRIC ROAD CRANE LIFTING TEST LOAD

The jib, it will be noticed, has an angle in its length, so that it may be swung round behind the cab of the chassis, and when travelling on the road it is housed in that position, as shown in one of the illustrations. An indicator is connected with the jib to show the radius to which it is luffed, and the loads for several radii are marked on it.

During our visit to Derby we saw the crane go through all its manœuvres, and it struck us as being very handy for operation, specially in consideration of the fact that it is driven by only one motor. The driver could pick up or lower the load quite gently. It was also noteworthy that the petrol engine required no attention while the crane was being used, so that an extra attendant is not required.

CALENDARS, DIARIES, &c.

RUSTON AND HORNSBY, Limited, Lincoln.—Very neat wall calendar.

WM. FIRTH, Limited, Leeds.—Wall calendar with portraits of the founder and directors. Monthly tear-off sheets.

W. JOHNSON, GILL, SEALE AND CO., Limited, 322, High Holborn, W.C. 1.—Wall calendar with monthly tear-off sheets.

PECKETT AND SONS, Limited, Bristol.—Wall calendar with a view of an engine reproduced in colour. Monthly tear-off sheets.

SUBMARINE SIGNAL COMPANY, Friars House, New Broad-street, E.C.—Small desk calendar with monthly tear-off sheets.

T. ROBINSON AND SONS, Limited, Rochdale.—Desk calendar with daily tear-off sheets. A view of the works has been reproduced.

ENGLISH ELECTRIC COMPANY, Limited, Queen's House, Kingsway, W.C. 2.—Neat wall calendar with daily tear-off sheets.

THE DIAMOND BLOWER COMPANY, Limited, 91–93, Bishopsgate, E.C. 3.—Small match cases for paper matches. A very acceptable gift.

HART ACCUMULATOR COMPANY, Limited, Marshgate-lane, Stratford, E. 15.—A desk blotter with a year's calendar on each sheet of blotting paper.

HULSE AND CO., Limited, Ordsal Works, Manchester.—Wall calendar with monthly tear-off sheets. A reproduction of a machine tool appears on each sheet.

BROWN, BAYLEY'S STEEL WORKS, Limited, Sheffield.—Calendar with monthly tear-off sheets. A short article is reproduced on "How Steel is Case-hardened."

MILNER, HURD'S PATENTS COMPANY, Limited, 4, Paradise-square, Sheffield.—Coloured view of an installation on a large wall calendar. Daily tear-off sheets.

MARSHALL, SONS AND CO., Limited, Gainsborough.—Desk calendar with monthly tear-off sheets. A picture of a steam roller in colours has been reproduced on the card.

C. ISLER AND CO., Limited, Bear-lane, Southwark-street, S.E. 1.—Wall sheet with a calendar for the year at a glance. Views are given of work carried out by the company.

J. I. THORNYCROFT AND CO., Limited, Thornycroft House, S.W. 1.—Neat desk calendar with an engraving which embraces all the activities of the firm. Monthly tear-off sheets.

UNDERGROUND RAILWAYS, Electric Railway House, Broadway, S.W. 1.—A desk diary pad. A week to a page is allowed for, and the pages are got up in very attractive style.

URQUHART, LINDSAY AND ROBERTSON ORCHAR, Limited (associated with Fairbairn, Lawson, Combe, Barbour, Limited), Dundee.—Wall calendar with monthly tear-off sheets.

BRUCE, PEEBLES AND CO., Limited, Edinburgh.—An up-to-date desk calendar, constructed of metal, with a special mechanical arrangement for cros ing out each day as it finishes.

FULLER'S UNITED ELECTRIC WORKS, Limited, Woodland Works, Chadwell Heath, E.—A refill calendar for the Ebonite desk calendar holder and paper weight supplied last year.

BROOK, HIRST AND CO., Limited, Northgate Electrical Works, Chester.—Well-produced desk calendar having monthly cards on which appears a reproduction of one of the firm's specialities.

HAYWARD-TYLER AND CO., Limited, 99, Queen Victoria-street, E.C. 4.—Pocket diary, one week to a page. A large amount of data for water supply has been embodied in the diary.

EDWARD WOOD AND CO., Limited, Ocean Ironworks, Trafford Park, Manchester.—Compact pocket diary, full of tables and valuable information. Wall calendar with monthly tear-off sheets.

J. ROGERSON AND CO., Limited, Wolsingham S.O., Co. Durham.—Wall calendar with monthly tear-off sheets. Views of different items of work carried out by the company are reproduced on each page.

BRAITHWAITE AND CO. (ENGINEERS), Limited, 117, Victoria-street, S.W. 1.—Pocket diary. Views of the firm's works have been included, with much useful information and tables for structural engineers.

MAWDSLEY'S, Limited, Zone Works, Dursley, Gloucester.—An attractive calendar. The picture of a lady, entitled "Looking Forward," has been reproduced on satin. There are monthly sheets for the calendar.

HAWTHORN, LESLIE AND CO., Limited, Forth Bank Works, Newcastle-on-Tyne.—Wall calendar with views of different locomotives which have been manufactured by the firm. Daily tear-off sheets with monthly slips.

SIMPLEX CONDUITS, Limited, Garrison-lane, Birmingham.—As usual, we have received one of this firm's very useful pocket diaries. This year its form is a loose solid calf cover with an inset. The pages are ruled sectionally for the use of engineers. Some tables have been left out, and others which the authors consider of more importance have been embodied. Prices are correct up to the time of going to press.

Railway Matters.

COINCIDENT with their incorporation in the Southern Railway, the Isle of Wight railway companies have abolished second-class.

PROVISIONAL agreements have now been made for the absorption by the London, Midland and Scottish Company of the Maryport and Carlisle and the Mold and Denbigh Junction companies.

THE Stretford Urban District Council, which has powers to make certain light railways in the Manchester area, has informed the Ministry of Transport that it is desirous of proceeding with the work, and is in negotiation with a view to the removal of certain difficulties which have arisen in connection with the crossing of the Bridgewater Canal.

IT is officially announced that the headquarters of the Southern Railway will be at Waterloo; that the chairman will be Sir Hugh Drummond, and Mr. J. J. Brewer, secretary of the London, Brighton and South Coast, the secretary. No general manager has yet been appointed; the three present general managers are to continue in office until the reorganisation is complete.

VERY extensive improvements and additions are being made by the London and North-Eastern Railway (Great Central section), Metropolitan Railway, and London, Midland and Scottish Railway (North-Western section) to deal with the traffic for the British Empire Exhibition and Sports Stadium at Wembley. Most of these will be ready for use at the Football Association cup tie in April.

IT is said that it is proposed to form in various parts of the country local joint committees under the Railways Act, 1921, to deal with railway matters of local contention, and make representations to the Railway Rates Tribunal on such subjects as passenger train charges and services, merchandise train services, collection and delivery of merchandise, and delays to traffic. Efforts will be made to make the committees fully representative, and it is suggested that each should consist of four members representing the civic authorities in the area, trade organisations, the Chamber of Commerce, and the local railway companies. Authority is given under the Act to local committees to make arrangements on minor matters without reference to the Railway Rates Tribunal. Some chambers of commerce are already moving in the matter.

THE report of Major Hall on a collision which occurred at Retford, Great Northern Railway, on November 16th, was issued on the 13th inst. A dense fog prevailed, during which a Great Central up-passenger train was admitted into the station, and because it was there the man at the North signal-box kept his signals against a Great Northern up train. He says he subsequently received the train-out-of-section signal for the former, so admitted the Great Northern train. The Great Central was, however, still there, and a collision ensued, in which ten passengers and a guard were slightly injured. Major Hall recommended that the line be track-circuited and a calling-on arm provided. The home signal could not then be lowered if a train were in the station. Only the calling-on arm would respond, and that would indicate that the line was occupied.

THE tonnage of freight traffic conveyed in October, 1922, was, according to the recently issued statistics of the Ministry of Transport, greater than in any month since March, 1920, and an increase of 24.7 per cent. over October, 1921. General merchandise secured an increase over October, 1921, of 8.8 per cent., coal, coke, and patent fuel 28.7 per cent., and other minerals 29.7 per cent. The tonnage under the second head was the highest recorded since the monthly statistics began in January, 1920. The average length of haul fell from 55.7 to 52.1 miles, and the increase in net ton-miles was only 16.7 per cent. as compared with 24.7 per cent. greater tonnage. The receipts were 3.5 per cent. less than in October, 1921, but 7.8 per cent. more than in September, 1922. The freight train mileage was 11.5 per cent. more than in October, 1921, the average train load increased from 125 to 130¼ tons, and the net ton-miles per engine-hour rose from 434 to 457.

No decision has yet been reached by the Ministry of Transport on the application of the railway companies to postpone the presentation of their standard rates and charges. Under Sec. 30 of the Railways Act, 1921, the schedule of standard charges on which the standard revenue is to be based should have been presented by December 31st, but an application was made to extend the period by six months. The Minister of Transport is in communication with the railway companies with a view to reducing the period of delay. When the schedule is presented it will be considered at a public inquiry by the Railway Rates Tribunal, who will fix the appointed day for it to come into operation. The standard charges are to be such as will, together with the other sources of revenue, yield, with efficient and economical working and management, an annual net revenue equivalent to that of 1913, though certain allowances are made for expenditure since 1913.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the eleven months ended November 30th last, was as follows, the corresponding figures for 1921 and 1920 being added in brackets:—Locomotives, £4,785,110 (£7,245,355, £5,197,825); rails, £2,281, 534 (£2,757,390, £2,438,747); carriages, £1,812,025 (£1,464,461, £1,553,862); wagons, £3,037,002 (£5,533,470, £5,213,097); wheels and axles, £1,100,970 (£1,603,312, £1,735,240); tires and axles, £391,588 (£1,214,060, £1,255,318); chairs and metal sleepers, £1,949,961 (£1,346,523, £1,245,471); miscellaneous permanent way, £1,284,753 (£2,430,196, £2,176,879); total permanent way, £7,178,045 (£9,586,127, £8,965,300). The weight of the rails exported was 231,945 tons (148,552 tons, 120,252 tons), and of the chairs and metal sleepers, 137,703 tons (58,815 tons, 57,935 tons). During November locomotives to the value of £161,070, were shipped to other countries in Europe than Spain, and of the value of £152,752 to India. Rails to the value of £65,932 were shipped during November to India, to the value of £22,264, to Australia, and of £11,489 to Portuguese East Africa.

Notes and Memoranda.

IT is reported that Professor K. A. Clark, of the University of Alberta, at Edmonton, has been successful in perfecting a practical method of extracting bitumen from the tar sands of the Athabaska region, in that province. The freed bitumen is used for surfacing roadways. The Alberta Government has ordered several car loads of tar sands, which will be put through this process at Edmonton, and the product used in surfacing mud roadways where the traffic is heavy.

AN Australian engineer, Mr. Theo. M. Harrison, is reported to have perfected a hydraulic press for use in the pressed metal industry. The inventor claims that in his process the costly hand-cut dies are completely eliminated, being replaced by iron castings at a fraction of the cost of the dies. These castings are tooled only to remove any marked roughness, and the matching piece or container is only cast to an approximate shape of the article to be produced. The press consists of stout uprights carrying overhead gear, which operates a shaft with two excentrics or cranks, and two arms on which the die is hung, the latter being raised or lowered by the movements of the shaft. On the bed of the machine is a cavity in which is affixed a rubber water bag specially designed to withstand high hydraulic pressure.

THE Johannesburg Town Council has decided to call for tenders for one turbine set of a capacity of 8000 kilowatts, with switchgear, cables, &c., and one 45,000 lb. boiler, the total estimated cost being £75,000. The Council, before deciding on the three schemes submitted to it by Mr. B. Sankey, general manager of the Electric and Tramways Department, for dealing with the power problem of the city, has decided, according to the *South African Mining and Engineering Journal*, to get further information. The first scheme is to build a new power station at Klipspruit, at a cost of £860,000; the second, to utilise the old gas engine station as an engine-room, and adding a new boiler-house, at a cost of £490,000; the third, to add to the present plant, at a cost of £400,000. There is at present much controversy about this important scheme, both inside and outside the Council Chamber.

AS the result of a study of brass furnace practice in the United States, the Bureau of Mines declares that the complete substitution of electric furnaces for the crucible and oil-fired types should result in savings in the brass melting industry amounting to two or three million dollars a year. The Bureau estimates that if all brass made in the country could have been melted electrically in 1917 and 1918 the war expenses of the country would have been reduced some twenty million dollars. The manufacture of brass in the old-style types of furnace has been characterised by enormous losses of zinc through vaporisation, possibly as much as 6 per cent. of the metal present having been lost in making brass castings and 10 per cent. in making wrought brass. It has been estimated that 7500 lb. of zinc passed into the atmosphere daily in the form of zinc oxides from the chimneys of the brass-casting shops of Waterbury, Conn., alone.

THE scheme for building an under-sea tunnel across the Shimonoseki-Moji Straits, which has been contemplated for some time by Japan's Department of Railways in order to facilitate railway services between the island of Kyushu and the main island, is ready, says the *Trans-Pacific*, for execution. Instead of its being carried out by the Department itself, there is a probability that it will be given to some foreign contractor who has had experience in operations of this kind. American contractors are believed to have the best chances of winning the award. The proposal was formulated a few years ago when the present ferry system was found inadequate for the increasing traffic between Shimonoseki and Moji. A survey and study of the sea bed of the straits was started and an elaborate tunnelling scheme has resulted, which will become a definite programme as soon as the Department's committee of experts approves.

PREVENTION of static interference in the reception of radio signals has been solved, it is stated, by an invention of Dr. B. Galen McCan, of Ephrata, near Lancaster, Pa., U.S.A. Two different systems have been developed, and in California this summer a static of 6000 audibility was reduced to five, at which time commercial signals were received at 250 times the strength of the static. The second system has produced results superior to those obtained in California. Tests have been made with the latest scheme at 360 m., on which a broadcasting system is operated, and it is known that the device will operate on all radio systems at any wave lengths. The latest device is free from critical adjustments, and is absolutely stable in operation, requiring no attention. The fact that it operates on an aerial makes it applicable for use on ships at sea, and becomes another important factor in life-saving by assuring absolute communication between vessels in conditions in which they cannot now operate.

A SERIES of experiments in Transatlantic radio telegraphy was recently completed in South London by members of the Radio Society of Great Britain, the organisation formerly known as the Wireless Society of London. The object of the experiments was to show the practicability of communication between this country and America on a far shorter wave length and much lower power, and with a much smaller, less complicated and expensive aerial than are used by the official and commercial stations. The experiments were made on ten successive days, from December 22nd, with apparatus installed at the base of the chimney on the premises of the County of London Electric Supply Company at Wandsworth. The aerial consisted of six wires on a hoop 5ft. in diameter, fitted to the chimney, 170ft. high. The maximum wave length used throughout the ten days was 200 m., and the maximum power 1.5 kilowatts. The call number of the station was 5 W.S. These successful experiments were a unique achievement for British amateurs. Official and commercial stations, when communicating with America and other distant countries, use wave lengths of from 15,000 m. to 30,000 m., and power from 250 to 350 kilowatts. The tests impressed the authorities, who had been inclined to doubt their usefulness ever since the society first contemplated making them, nearly a year ago.

Miscellanea.

THE British Industries Fair will be opened at Castle Bromwich, Birmingham, on Monday, February 19th, and will remain open until Friday, March 2nd.

ADDRESSING the Midland Section of the Junior Institution of Engineers at Birmingham on December 12th, Dr. C. C. Garrard, of the General Electric Company, Limited, said that much good work of the Engineering Standards Association was being wasted because the specifications issued by it were not used to the proper extent.

BEFORE the Institute of Radio Engineers, New York, on December 20th, Mr. Harold P. Donle, chief engineer of the Connecticut Telephone and Electric Company, read a paper on "A New Non-Interfering Detector." A recent form of highly-sensitive three-element detector, utilising the ionisation of metallic atoms, was described and its practical application illustrated.

THE output of coal from the Malayan collieries at Batu Arang, Selangor, Federated Malay States, in the first half of last year amounted to 64,921 tons compared with 148,278 tons in the corresponding period of 1921. The mine, it is reported, is in better working condition now than it has ever been, and the danger from spontaneous combustion has been largely eliminated by the process of sand filling. The decrease in output is due to a falling off in the local demand.

IT is announced in New York that the Byllesby Engineering and Management Corporation has planned a programme for new electric, water and steam power construction and development for Minneapolis and St. Paul, involving an estimated expenditure of 80,000,000 dollars. The new construction will extend over a period of about ten years and will increase by about 306,000 horse-power the electric generating capacity of the Northern States Power Company. This company serves 350 cities and towns in Minnesota, the Dakotas, Wisconsin, Illinois and Iowa, and is one of the operated properties of the Standard Gas and Electric Company.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in December amounted to 533,700 tons, an increase of approximately 40,000 tons over November and the highest total attained since January, 1921. This figure represents 62 per cent. of the average monthly production of 1913. The number of furnaces in blast at the end of December was 169, compared with 162 at the end of November and 77 at the end of December, 1921. The production includes 179,000 tons of hematite, 153,200 tons of basic and 167,500 tons of foundry and forge pig iron. The output of steel ingots and castings fell owing to the Christmas holidays from 600,800 tons in November to 546,100 tons in December.

FOLLOWING the report of the Fuel Economy Committee of the Chemistry Section of the British Association, in which it was recommended that local education authorities would help fuel economy by the institution of properly organised courses of instruction for the lower grades of boiler-house workers, the Education Committee of the Sheffield City Council have adopted the scheme proposed by Mr. Charles F. Wade, A.M.I. Mech. E., A.M.I.E.E., for the purpose mentioned. The very gratifying results in the number of students obtained is mainly due to the active support of the Sheffield Chamber of Commerce and other local manufacturers, many of which have arranged to pay the fees of any of their employees who are attending the course of twelve lectures which have been arranged.

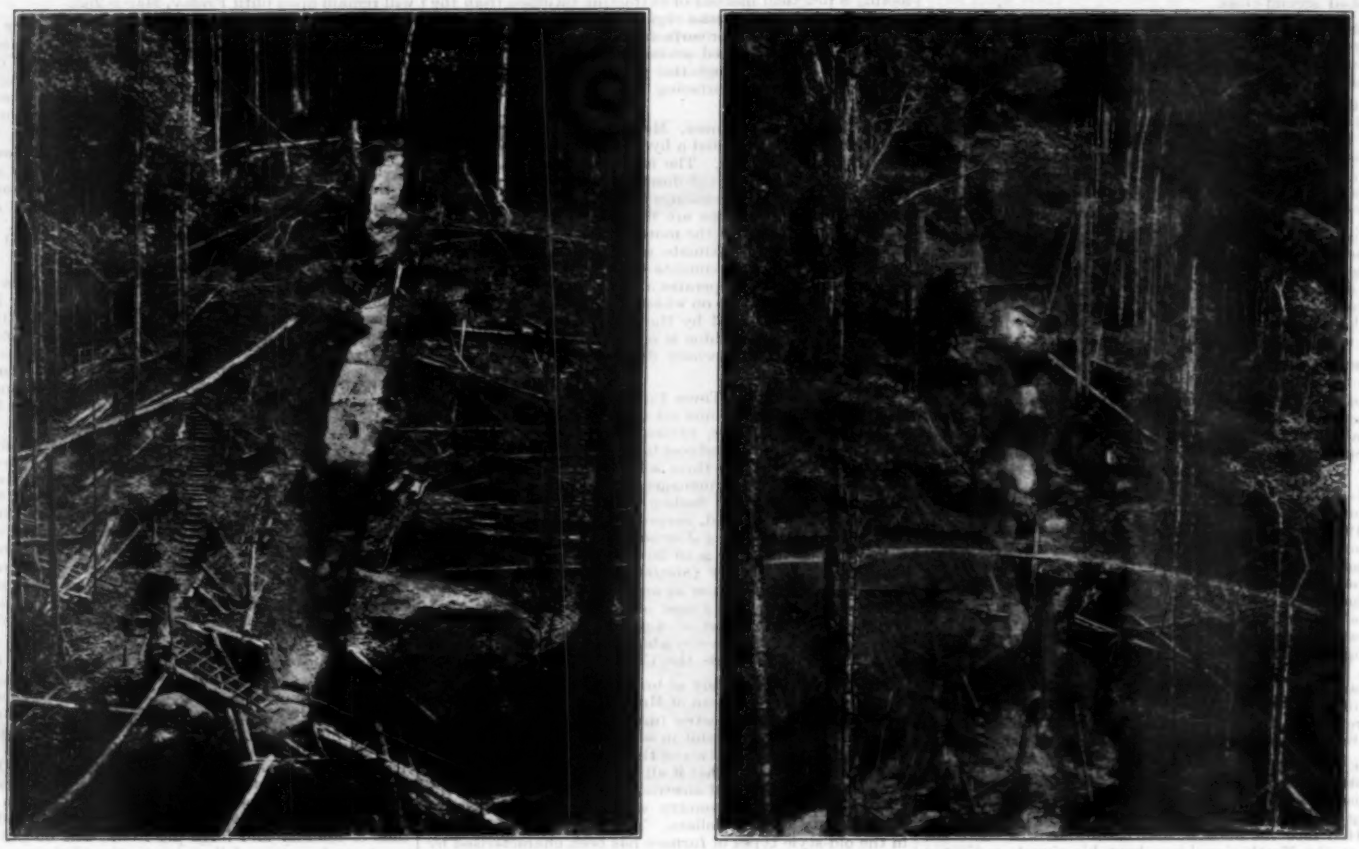
THE bulletin of the Suez Canal Administration states that the ore traffic through the canal has never been so brisk as it was in October, 1922, when 176,000 tons of various kinds of ore passed through. Of that quantity 139,000 tons were manganese ore, which is by far the largest tonnage registered in any month, not excepting pre-war days. The total ore shipments through the canal just before the war amounted to 1,189,000 tons in 1911, 1,231,000 tons in 1912, and 1,560,000 tons in 1913. Since the Armistice the quantities were 560,000 tons in 1919, 1,015,000 tons in 1920, 844,000 tons in 1921, and 1,164,000 tons in the ten months ended with last October. It is expected that the final figures for 1922 will show a total of 1,450,000 tons, or only 110,000 tons less than in the record year 1913.

WHAT is reported in the *Iron and Coal Trades Review* to be the largest blast-furnace in Asia was set in operation recently at the Hirapur works of the Indian Iron and Steel Company, Limited, Asansol. Mr. G. H. Fairhurst, managing director of the company, gave a brief description of the works, stating that the furnace was designed to turn out 400 tons of pig iron per day. To reach this output a total of 1600 tons of material and products would have to be handled daily. It was also stated that the company's first by-product coking plant was now operating successfully, involving the daily handling of a further 1800 tons of material and products, and that in the first few months of 1923 the capacity figures would be doubled with the putting into operation of the second coke oven battery and the second blast-furnace.

HIS MAJESTY'S Chargé d'Affaires at Santiago, Chile (Mr. C. H. Bateman), in a recent dispatch to the Department of Overseas Trade, calls attention to the importance of United Kingdom firms interested in Chilean Government contracts keeping the various Government Departments in that country supplied with copies of their catalogues and other trade literature. American and continental firms, Mr. Bateman states, are constantly forwarding catalogues, reviews, calendars, framed photographs, &c., of their products to the different Departments of the Chilean Government, whereas only a very limited number of catalogues of British products are to be found in these offices. Such publications are regarded as convenient and handy sources of reference and are largely consulted in the Government Departments concerned. These Departments, when calling for public tenders, on different occasions adopt certain models shown in the catalogues they have studied, and for this reason it would be to the interest of British manufacturers to keep the Departments supplied with catalogues printed, if possible, in Spanish and showing metric weights and measures.

SINGAPORE WATER SUPPLY—SITE OF THE PROPOSED DAM ON THE PULAI RIVER

(*For description see page 57*)



EXCAVATIONS ON EITHER SIDE OF THE VALLEY FOR FOUNDATIONS OF DAM

SITE OF THE DAM, LOOKING UP-STREAM

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THE ENGINEER.

JANUARY 19, 1923.

The Marine Diesel Engine.

AT the beginning of 1923 we are faced on every side with evidence of the increasing importance of the marine internal combustion engine, which we do not hesitate to say will prove a dominating factor in British marine engineering of the future. If marine engineers were slow to appreciate the early developments of the internal combustion engine and the first efforts which were made to apply this new form of prime mover to the propulsion of sea-going vessels, it cannot be said that such development has been neglected in recent years. In the years immediately prior to 1914, and throughout the war period, advances were made, especially in the building of the submarine type of engine, which familiarised many engine builders with the peculiar difficulties of marine oil engine practice. Since 1918, the greatest progress has undoubtedly been made in the construction of standard engines for cargo ships. The motor liner of moderately large power is now an accomplished fact, and we are already within sight of the large naval vessel propelled by internal combustion engines. The interest and enthusiasm for the marine oil engine and the problems inseparably connected with its design, construction and operation are well reflected in the papers which are read before the technical institutions. This is particularly noticeable in the case of the institutions immediately associated with the engineering and shipbuilding industries on the Tyne and Clyde.

The first meeting of the North-East Coast Institution of Engineers and Shipbuilders this year was devoted to a review of different types of marine internal combustion engines, and the Council of the Institution is to be congratulated on the response made by various engine builders and the variety and completeness of the schemes put forward for discussion. It was perhaps hardly to be expected that one particular size of cargo vessel would fit in equally well with the standardised production of every engine builder, but altogether seven schemes were submitted, and with the exception of two noted types of four-cycle engines the list is complete. The difference in type is marked, for two designs of four-cycle machinery, three designs of two-cycle machinery, and two opposed-piston engines are represented. With the exception of the Vickers proposal the horse-powers of the engines are singularly equal; they do not vary more than from 1 to 2 per cent., and the machinery weights show a corresponding regularity. In general, the saving in weight compared with a similar steam engine installation appears to be about 15 to 17 per cent. The familiar cylinder ratio between the two-cycle and four-cycle types is apparent, the former type of engine requiring only four cylinders, and the latter six cylinders for a given output. With the Doxford proposition the number of cylinders is reduced to three, but the weight and size of the engine is not very different from that of the other types. The cylinder diameter varies from a minimum of 21in. up to 29in. and the relation of bore to stroke approaches in some cases the 1 : 2 ratio which has been so successfully used in Scandinavian cargo ships fitted with Burmeister and Wain type engines. These long-stroke engines are now also built by Harland and Wolff. Throughout, a comparatively low speed of revolution is retained, and the speeds vary from 95 to 112 revolutions per minute, 95 revolutions being the mean. The question as to the overload capacity of the engine has in most cases been answered, and the two opposed-piston engines and the Scott-Still engine are most favourable in this respect. In the latter case the assistance of the steam side of the cylinder is very clear, and is shown in the high mechanical efficiency—88 per cent.—which is claimed. The 82 per cent. for the Doxford engine is a remarkably good figure, and so is the 78 per cent. given for the Vickers engine. In most other cases a more conservative figure varying from 73 to 75 per cent. is given. Turning to the fuel consumption, here again striking equality is shown, the figures given only varying between 0.386 lb. and 0.43 lb. of oil per brake horse-power-hour for the main engines alone. When the auxiliaries are added a wider difference is noted, but this in many cases is explained by the difference in the sizes and powers of auxiliaries put forward. Several makers have availed themselves of the opportunity of including a scheme with electrically operated auxiliaries. In most cases the weights for the steam and electric schemes are about equal, but it is safe to say that the cost of the electrical equipment is much higher. Where a donkey boiler is installed there is a marked tendency to use steam turbine-driven blowers and pumps. This is perhaps only natural considering the familiarity of the sea-going engineer with such machinery, but it behoves the electrical manufacturer to meet the demand for a high-speed marine type of motor, especially for turbo-blowers. In the case of the Armstrong-Sulzer proposal, we note that in the scheme with electric auxiliaries the scavenge pump is arranged on the main engine to avoid the necessity of fitting a high-speed motor-driven scavenge blower. It is stated that at the present time some difficulty is being experienced in connection with a British-built motor of this particular type. There is little doubt that this question will be dealt with in the discussion of the review. A point of interest is raised by the replies given to the question of using boiler fuel oil continuously. Although experiments have shown that there is no real difficulty in burning heavy oils of this type over prolonged periods, there is certainly great danger of pistons and liners becoming scored by particles of ash and of deposits forming, which for their removal will entail more frequent overhauls and attention. This is a matter which might well engage the attention of oil companies, with a view to removing these detrimental qualities from standard fuel oils. A matter affecting the shipbuilder and the registration societies is the revision of the rules for the size of machinery space to obtain the reduction from the gross tonnage. The diminution in engine-room length is particularly noticeable in the Scott-Still scheme, where the difference between the length required and that shown on the standard drawing is about 17ft.

Speaking generally, the schemes put forward augur well for the future of the British motor ship. The Camellaird-Fullagar engine and the Doxford, Vickers and Scott-Still engines owe much to British inventive genius and capacity for working out designs to a successful issue, and other makers, availing themselves of continental help, have influenced their adopted designs in the direction of conformity to the recognised high standards of British marine practice. Whilst naturally we feel some regret that in many cases British makers are still not only employing foreign designs, but are even dependent upon foreign firms for the supply of certain parts, it is made abundantly evident by this Review organised by the North-East Coast Institution that our own shipbuilders and marine engine builders are now attacking the matter with energy, and we are inspired with the hope that before many years are past our reliance on foreign

designers and builders will cease, and that Great Britain will lead in the construction of internal combustion marine engines as she has long done in steam marine engines and turbines.

The Liability of Employers.

WHAT seems to us a somewhat surprising judgment was given recently by Judge Scully, of the Marylebone County Court, in a compensation claim. Briefly stated, the claim was by a boy of fifteen for serious illness contracted by inhaling the vapour of carbon bisulphide during his employment at the factory of a rubber shoe maker. The factory was not one of the two or three concerns in Great Britain specially engaged in the golosh and rubber boot manufacture, but a small one making a special line. The facts as to the boy's illness were not in dispute, though there were different opinions as to the efficiency of what ventilation there was in the workroom. It was contended by counsel for the claimant that as the dangers associated with carbon bisulphide vapours were common property in the rubber trade and were the subject of special regulations under the Factory Act, the management of the works in question were culpable for not taking the usual precautions to prevent injury to the health of the workpeople, such omission, he contended, being clear evidence of negligence. The judge, however, brushed this aside, stating, in effect, that he could not accept the wide and far-reaching proposition that it was the duty of persons engaged in an industry to know whether the processes they employed or proposed to employ were dangerous. In this case, he said, there was no evidence that the management knew that there were dangers associated with breathing the fumes of carbon bisulphide; the applicant would therefore be nonsuited with costs.

This decision may be good law, but it hardly seems to be good sense, and it opens up a vista of possibilities which we cannot contemplate with equanimity. Ignorance of the law, we know, is no excuse, and it certainly comes as a surprise to find that a manufacturer can put people to work with chemicals of a noxious, and presumably also, explosive, nature, and as long as he remains in ignorance of their properties or propensities he is not guilty of negligence if anything untoward happens to the health or lives of his workpeople. If it can be shown that he is fully aware of the properties of his materials, and knows that others in his position customarily adopt specified precautions, then if anything goes wrong he can be found guilty of contributory negligence if he has failed to take similar precautions. This does not seem a very satisfactory state of affairs, putting as it does a premium on ignorance. That a dog is entitled to his first bite is a legal maxim with which we have never had much sympathy, common fairness suggesting that where damage has been done the responsible party should be held liable for a cash payment, which in many cases is by no means an adequate exchange. It was stated by counsel at the trial under notice that the new regulations for the cold cure of rubber did not come into operation until May, 1922, and that even if the defendants had been cognisant of them they did not apply to their particular trade. These new regulations relating to fume processes in the rubber manufacture, we may explain, have special references to the conditions under which workpeople may be employed in the cold cure rooms of rubber factories, these regulations replacing those first issued about twenty years ago. Before that time there were no regulations, and it is not surprising that cases of illness were many and serious. It is certainly no exaggeration to say that the first regulations under the Factory Act were long overdue, and though to some employers the new ones may seem unnecessarily irksome, we do not think they transcend that minimum safety limit to which labour is legitimately entitled. We have yet to meet the man who professed a predilection for working with that most mephitic liquid, carbon bisulphide, and everyone must agree that a *prima facie* case exists for coercive methods of regulation. To revert to the statement that the regulations apply only to rubber works, we note that this is merely the *ipse dixit* of counsel, and that the factory inspector who gave evidence expressed the opinion that the rubber works' regulations covered that particular case. The point seems an important one which calls for a ruling from the Home Office, because there are many places where either the cold curing of rubber is carried on or where rubber dissolved in carbon bisulphide is used for certain purposes. Whether it is desirable that all such places should come under the rubber works regulations we are not anxious to express an opinion; but it is clear that an authoritative statement as to whether they do or do not is highly desirable. If they do, then the necessary steps should be taken by the factory inspectors to bring to the proprietors' notice the obligations they are under; if they do not, then the advisability of further legislation seems to call for consideration.

We may add that the new fume regulations for rubber works apply, though in a somewhat different way, to benzol, the toxic nature of this body having been forcibly demonstrated during the war by the deaths of two men at a rubber works where benzol had been utilised as a solvent in place of the usual solvent naphtha. Similar cases were reported from America, and the hitherto unsuspected danger attaching to this liquid has been promptly dealt with by our authorities. Efficient ventilation is now compulsory in rubber works, though whether anyone employing workpeople on a job where rubber solution made with benzol is used comes under the regulations we do not know. As, however, there is no need to use solution made with benzol—other equally good solvents being available—the employer of labour in this case is more favourably situated than is the user of carbon bisulphide in the cold cure. With regard to the new regulations, it should be mentioned that it is expressly stated that they shall not apply to processes in the repair of any article, and also that where it is proved to the satisfaction of the Chief Inspector of Factories that by reason of the restricted use of carbon bisulphide and other poisonous solvents in a factory or workshop the regulations are not necessary to safeguard the health of the workpeople, a written certificate of exemption may be given. In the present case, stated not to come under the regulations, we find the inspector who prosecuted indicating that no certificate of exemption had been given. Other firms in a like situation should therefore find out how they stand.

Obituary.

AMBROSE FIRTH.

THE engineering profession and the city of Sheffield are regrettably the poorer by the death of Mr. Ambrose Firth—the Chairman of the Brightside Foundry and Engineering Company, Limited—which occurred at Bournemouth on the 11th inst.

Mr. Firth, who had been aptly described as being "in the truest sense of the term a self-made man, and, what is more, a practical man," was born at Grimesthorpe in 1845. But for his death he would have completed his seventy-eighth year within a few days. He was, when very young, apprenticed in a foundry and engineering works which stood on ground now occupied by the works of Thomas Firth and Sons, Ltd.. Sheffield. The identity in names was a pure coincidence, as we believe that there was no connection whatever between the subject of this memoir and the firm mentioned. Towards the close of 1865 he started in business on his own account as an iron founder in a very modest way, his foundry—at first but a small shed—being in a field on the bank of the river Don. It is recorded that the first week's wages bill amounted to the large sum of £6. The original foundry disappeared long ago, its site having been included in the area now occupied by the works of Vickers, Limited. Quite an event was made of the firm's first really heavy casting, an anvil block weighing some 20 tons. A party of manufacturers and others was invited to witness the operation. As a contrast our readers may be reminded that a year or so ago the Brightside Company made its record casting, which weighed 112 tons.

It was only a few years before Mr. Firth found his original works too small for him, and so he acquired what were known as the Old Newhall Running Grounds. He turned the grand stand into a pattern store and an existing hotel into offices. For some time this larger space was sufficient to satisfy the growing needs of the business, but eventually it, too, became too small, and the Carbrook Works and the Wicker Ironworks were started. In these the making of large rail rolling mills was commenced and in time very considerably developed. Even these additions were not for very long adequate to allow for expansion, and the following businesses were at various periods acquired and absorbed into the Brightside Foundry and Engineering Company:—J. C. and J. S. Ellis, heating engineers, London; Jas. France Hill, heating engineers, London; Clayton, Howlett and Co., London; Hunter and Middleton, London; Pullan and Mann, Leeds, manufacturers of brick-making machinery; Walker, Eaton and Co., Sheffield, ironfounders; John Robinson, Royds Foundry, Sheffield; and Moorwoods, Limited, of Brightside, who were also specialists in large castings as well as other branches of engineering.

In all this development Mr. Firth played a predominating part. The type of work undertaken in the original foundry was the casting of ingot moulds and of rolls for the heavy steel trades; but he was not long to remain content with such restricted production, and he launched out into the manufacture of steel works plant of all descriptions, including, in addition to those already mentioned, specially powerful forging presses, forge equipment, hydraulic machinery, brick and tile presses, colliery decking plants and machinery, heating and ventilation installations, &c. It is only a couple of years ago that he relinquished active participation in the conduct of the firm, while still holding the office of chairman, and went to live at Bournemouth. For many years previously he had been accustomed every morning to catch the 9 o'clock train from his home at Bamford, in Derbyshire, on his way to work.

In spite of the great tie of his own particular business Mr. Firth found time to act as a director of Messrs. W. Cooke and Co., of Tinsley, and as chairman of the Hathersage Gas Company. For many years, too, he was one of the leading representatives on the employers' side in matters affecting local engineering industries. He was a member of the Institution of Mechanical Engineers, of the Iron and Steel Institute, and of the Sheffield Chamber of Commerce. He was a Justice of the Peace for the County of Derbyshire, and had a seat on the Derbyshire County Council.

We cannot do better in closing this notice than give the following appreciation of Mr. Firth from the pen of one who had long been in close association with him:—"Mr. Firth had a great faculty for inspiring those in his employ with a desire to give their best services, and a proof of this is the fact that the various branch managers are all men who were with the firm in their youth. One who joined the firm as a boy of fifteen now enjoys a seat on the board of directors. In all his business career Mr. Firth was a man of unimpeachable character, and in every way a man of whom his firm, associates, his employees, &c., and his city could be proud in the very highest degree. His whole business life might be held up as a striking example of what a thoroughly clean living, fair dealing, honest business man should be. He had a very kindly nature—slow to complain of one's shortcomings, ever ready to forgive, and to help in every way those who were in need. A kindly smile, an ever-ready pleasant word, and a tolerance of the faults of others, made him beloved by all who knew him. A clean, straight living man himself, he set a fine example to all, and the world would be better for more of his kind. In politics, religion, social and public affairs he exhibited a finely-balanced judgment, and was able to state his views in such a way that even those who did not agree with him could not take offence. To know him was to love him, and the writer feels that he for one has lost a very dear friend and benefactor."

Chinese Engineering Notes.

(From our own Correspondents.)

November 28th, 1922.

Peking.

A SENSATION has been caused in Peking by the arrest of the Minister of Finance, Mr. Lo Wen Kan, on a charge of appropriating Chinese Government funds. His arrest was effected at the instigation of the militarists, who are running the Peking Government at the present moment. There is no foundation whatever for the charges made against Mr. Lo, and it now appears that the step was taken simply with the object of embarrassing the President and Cabinet. It has had the desired effect, for Mr. Wang Chung Hui, the Premier, has resigned and with him Mr. Wellington Koo, the Minister of Foreign Affairs, and several of the other ministers. We are, therefore, again without a Government, and a good deal of wirepulling is going on between the various military factions to install a Cabinet which will run the country according to the dictates of these military pests. To put the situation in plainer language, the military people only want a Government that will not hamper them in commandeering the funds they require for their annual military adventures. In such men as Wang Chung Hui, Wellington Koo and Lo Wen Kan, we have men who are well versed in international affairs; they have the interest of their country at heart, and are upright, honest men. When men of this type can be arrested at will, it is difficult to imagine how China is ever going to induce her best men to come forward and take a hand in Government affairs. This is made still more difficult by the serious state of China's finances. In this connection a few figures will perhaps not be out of place. At the moment the total loans amount to £250,000,000. Of this amount the secured loans represent about £155,000,000, and the unsecured about £95,000,000. At the present moment a sum of £60,000,000 in unsecured loans is due for repayment, whilst the unpaid military, police and civil expenses amount to no less than £20,000,000. These figures would not be at all alarming if the Chinese Government could collect its revenue, but it can only rely on approximately £25,000,000 monthly. This serious state of affairs, however, need not arouse despondency in the minds of British engineering

firms, except those who rely entirely upon orders from the Chinese Government. The Chinese business man carries on in spite of these conditions, but, of course, there is not the demand, and there will not be, for machinery to the extent that there would be if a stable Government existed. One hears reports of various industrial schemes, such as waterworks, electric light plants, tramways, mines, &c. &c., which are in the course of preparation, and which will materialise in spite of the political unrest. In this connection I cannot help strongly endorsing the statements made in your leading article in the issue of October 13th, with regard to sending experts out to this country. The Germans are back in full force, and are doing business. They have always paid particular attention to the expert and language question, and their success in former years in this country was almost entirely due to this policy.

Shanghai.

Although there is still a slight trade depression there is at the same time an indication of an improvement in the engineering business. Trade with Chinese direct is increasing at a much greater rate than is observable by the average foreigner, who has no opportunities of getting out of the routine of his own particular office. The foreign merchant is approaching the time when the methods he has been teaching his Chinese assistants all these years will be used by those assistants in their own Chinese firms, and the foreign merchant will cease to be a necessary go-between for the maintenance of trade with the Far East. There are no particular secretive methods about the foreign merchant's business, and the Chinese assistant does most of the work, and hitherto has but felt that he carried insufficient weight to be capable of dealing direct with what has been to him that august personage, the home manufacturer, who lives in wonder worlds of transcendentally unattainable magnificence, like London and New York. But this feeling of incapability on the part of the Chinese assistants is disappearing with experience and travel and cinema shows. He finds that people at home are, if anything, less severe than his local "taipan," and, moreover, are quite willing to entertain him on equal terms by admission to their public parks and to their private drawing rooms. The only secret about the business has been the allocation of the profits, and the Chinese assistant has a rough guess that after deducting cost of upkeep, &c. &c., out here the profit goes towards the maintenance of style and magnificence elsewhere, but knowing that it was his country that provided the means, he is beginning to feel that he can do with the disposition of the profits himself. It is very difficult to forget this aspiration of the Chinese assistant when one constantly meets Chinese who speak several languages fluently and write them without serious error, and who have ingratiating manners to add to their business knowledge. There is no need, however, to consider the situation as developing into a setback to trade with China. Far from it. The more the Chinese know the more they want to live as foreigners live, and the more they need in the way of our finished products the more they will need our machinery to run in their manufactories. The home manufacturer should, therefore, seize every opportunity of co-operation with the Chinese direct, and give them every reasonable help in the way of expert assistance and mutually protected finance. The foreign firms have not failed to imbue their Chinese assistants with the spirit of business integrity, and in doing so are serving their country's best interests. And it is this very fact of the foreign firms' success being based upon honesty and financial stability that has maintained them, and at the same time impressed the Chinese assistant with the need of the practice of these virtues if they wish to succeed.

It must be very difficult for the home manufacturer to realise the size of China's possibilities. Statistics comparing China's trade with the trade of other countries are dry and unconvincing, and are often passed over as being figures relative to a country covered mostly with barren wastes or trackless forests peopled with inhabitants who have insufficient intelligence to buy. The home manufacturer in trying to think more than only imperially with a view to extending his overseas trade is handicapped by a lack of appreciation of China's present state of development, and it may convey to him some idea of it when he realises that China is forty times larger in area than the British Isles, and that one can travel from east to west of China, a distance of 2000 miles, in luxurious steamers, or part of the way by railway train. From north to south the railway travel extends all the distance except for a gap of about 600 miles, and it is that gap south of Changsha, in Hunan province, which is seriously deterring a better business and political understanding between the north and south. The trade routes either by steamer, launch, camel or pony or wheelbarrow converge in thousands on the trade centres, and the postal service reaches the uttermost confines of this huge country. The population of the valley of the Yangtsze River alone is three times that of the British Isles and, at any given point on the river between Hankow and the mouth of the Whangpoo River, which leads to Shanghai, at least five 3000-ton passenger steamers may be seen proceeding up and a similar number down the river every day and, in addition to this transportation, there will be seen several ocean-going steamers and many passenger launches, to say nothing of countless cargo and passenger junks. It is quite a usual thing to have 200 junks in sight at any time when one is on a steamer proceeding up or down the river. The traffic on the Yangtsze is enormous, as on to its broad waters the trade transport converges from countless tributary waterways. When it is realised that only about 5 per cent. of the clothes of this busy population are machine made, and that only about 1 per cent. of the transport is effected by machinery, it will be evident that there is a vast opening for trade in this region alone, and that this patient, toiling mass of humanity will soon want to save time and make more money by turning its labour into money more quickly through the adoption of our Western ways of efficiency.

Hong Kong.

The first taxicab has made its appearance in Hong Kong, and this enterprise opens up great possibilities. Nothing official has yet been published on this subject, but it is generally understood that the initiative comes from our French friends. About two years ago it was generally stated that the famous British B.S.A. firm was sending out to Hong Kong a fleet of about 100 new type motor cycles and sidecars suitable for carrying passengers and fitted with taxi meters. These cycle cars have not yet appeared, but it seems fairly certain that there soon will be a number of "Citroën" taxi cabs plying for hire in Hong Kong. They must have a profound effect upon the neighbouring Chinese City of Canton. That city is less than one hundred miles from Hong Kong, yet there is no road to it, although the Hong Kong Government has, during the last ten years, constructed a road about 60 miles long in the British territory on the mainland. Incidentally it may be mentioned that during the last ten years the Hong Kong Government has spent many millions of dollars upon the construction of new roads. This work has had a most stimulating effect in the import of motor cars. Ten years ago there were probably not half a dozen motor vehicles in the Colony, and now there are about 600. Hitherto nearly all of the imports in this line have come from America. This is an entirely free port except for opium, alcohol and tobacco, so the American cars enter tax free. There are a few British cars, including representatives from the Rolls-Royce, the Lanchester, the Sunbeam and Cubitt factories, but there are probably not twenty British cars in the Colony. This fact should give British motor car manufacturers furiously to think. It is hoped that British cars will in time capture the local market. If these "Citroën" taxi cabs are the success anticipated, there should be a good market here for the small 10 horse-power British car. Hitherto the local tradition has been that on account of the hills a high powered car is essential; but in actual fact the high powered car is a source of danger here. The roads are not only hilly but they are very tortuous; and with high powered cars there is a tendency to take the corners too quickly. With a small car there is no real hardship in using the gear box, although it is curious to hear local motorists explain that they can always take all but the worst hills on top gear. They have to pay for the statement in petrol and tires. At present the bulk of the passenger traffic is done by man-pulled rickshaws and the coolie-chair. It is only a question of time for the rickshaw to disappear. It is an invention less than a 100 years old, and it was the first wheeled vehicle to be used in South China.

The motor car opens up the problem of improving the conditions of the workers in China. The contrast between the rickshaw puller and the Chinese chauffeur presents a contrast to the humanitarian that is worthy of comment. The engineer by his inventions may claim the credit. The rickshaw puller receives about 10 dollars a month—25*s.*—for his muscular labour given often under a blazing tropical sun. The Chinese chauffeur receives a monthly wage six times as much, namely, 60 dollars. A European would not at all object to the job of chauffeur, but he would quickly decline to pull a rickshaw for any monthly wage. The Chinese chauffeur is a transformed rickshaw puller. He may be rather overpaid according to labour conditions in South China, particularly as you can obtain a first-class mechanic at 40 dollars a month, whose work is certainly much more arduous.

At present it costs the average car owner in South China about 200 dollars a month to run a car if depreciation is neglected. This outlay includes about 60 dollars for chauffeur and 100 dollars for tires, petrol and lubricating oil. The odd 40 dollars go in cost of garage, repairs, &c. With the small British car the operating cost should be less than 80 dollars a month. There is also a market in South China for British motor cycles and sidecars. The Americans have captured this market and they have been very enterprising. No doubt they deserve their success, as they emphasise the good points of their machines, and persuade Chinese buyers that they are the best type. One very seldom hears anything about fuel economy and the long life of British motor cycles. Yet there is nothing that appeals to the Chinese buyer more than the word "economy." It is, of course, largely a matter of education that makes a careful buyer, but British manufacturers might make special concessions in the matter of first cost in order to demonstrate the ultimate superiority of their machines. It is good news to read of the reductions which are taking place in the price of small cars and motor cycles outfits manufactured in Great Britain. They should enable us to see many more of these vehicles in the Far East.

A Whitworth Society.

On Friday evening, the 12th inst., there met in the lecture hall of the Institution of Mechanical Engineers a remarkable body of engineers. It was the occasion when all Whitworth Scholars and Exhibitioners were invited to discuss the formation of a society for keeping green the memory of the founder of the scholarships and for assisting the younger and less experienced members.

One of the most remarkable features about the meeting was the almost complete unanimity of thought, and it was seldom that anyone rose to oppose any of the suggestions. The reception of the first motion was typical of this attitude, and by it Dr. Hele-Shaw was voted to the chair for the meeting. He pointed out that the groundwork which had been done in preparation for the meeting had put a considerable strain on the staff of the Institution of Mechanical Engineers, and recommended that a secretary should be appointed for the new society. Mr. E. R. Dolby, of 8, Prince's-street, Westminster, was proposed and appointed immediately. The chairman then suggested that it would be necessary to appoint a committee, and in doing so pointed out that although attempts had been made to form a Whitworth Society before, and although those attempts had failed, there was a much better chance of success on the present occasion, as the executive positions were to be open to all Whitworth Scholars on the same footing, whereas in the past unsuccessful efforts the conduct of the Society was in a few hands only.

At this point Mr. T. Clarkson rose to urge that the formation of the committee should not be embarked upon too hastily, and suggested that a small sub-committee might be formed with the idea of tracing those Scholars whose addresses had been lost and of circularising them before the permanent committee was formed. Mr. Duff also suggested a delay of about six months in which to complete the list of possible members; but both these schemes were withdrawn when Dr. Hele-Shaw pointed out that the proposed committee would only act temporarily until the first annual meeting. It was finally agreed to ballot for a committee of ten members, with powers to co-opt two extra members if necessary.

Whilst the ballot papers were being counted the chairman read a number of letters from Scholars who were unable to be present, but who supported the scheme wholeheartedly, and enlarged upon the aims of the Society, which we have already indicated. Colonel J. H. Dobson, who had just returned from Johannesburg, suggested that the annual meeting should take the form of a dinner, as there was no desire to have technical discussions at the meetings, but rather to make them social functions, and later in the evening it was agreed to hold the dinner on December 21st, as that was the birthday of Joseph Whitworth. It was, however, stipulated, on the proposal of Mr. Johnson, that the committee should arrange for a dinner in about two months time, at which it could report progress. It was also decided that the Prizemen who come forward under the new scheme of administering the scholarships shall be eligible for membership of the Society.

Several suggestions were made as to the publication of biographies of the Scholars, and Dr. Hele-Shaw said that he thought a publisher might be found who would be willing to produce such a book, including a biography of Whitworth himself, as it would include the names of some most eminent engineers.

Professor Low proposed that Dr. Hele-Shaw should be the first president of the Society, and in doing so pleaded for a return of the practical examination, which has been dropped in the new arrangements for the competitions. The motion was seconded by Mr. Buckley, the senior Scholar, who said that he passed the examinations in 1869 and personally met Joseph Whitworth. The proposal was agreed to with great applause.

The names of those elected to form the temporary committee are as follows:—Dr. H. S. Hele-Shaw, Sir Henry Fowler, Dr. A. Morley, Professor E. G. Coker, Professor D. A. Low, Professor Lee, Professor W. E. Dalby, Professor E. W. Burstall, Mr. L. A. Legros, and Dr. W. A. Scoble.

THAT railwaymen are very temperate in their habits is proved by the fact that on only three occasions during the last twenty years has an accident report mentioned drink as a possible cause. The United Kingdom Railway Temperance Union is very strong, and receives considerable support. A noteworthy incident in its history was a meeting in the shareholders' room at Euston in February, 1908, which was presided over by the chairman of the company, who was supported by several directors and the chief officers. The Great Western branch of the Union has 15,000 members, and, recognising that intemperance has practically disappeared, it decided, at a meeting presided over by Viscount Churchill, the chairman of the company, to enlarge its scope and change its name to "The Great Western Social and Educational Union."

THE reference to transport of coal in the report, issued on the 12th inst., of the Advisory Committee for Coal and the Coal Industry, was as follows:—"It forms a very substantial portion of the total cost of coal to the consumer, and we are of opinion, particularly with regard to the export trade and other short-distance traffic, embracing the bulk of industrial coal transport, that further reduction in the rates must be effected as early as possible if the contribution which the coal industry has already made towards the revival of trade generally is to have full effect. We think that the flat rate—on the railways—should be removed, and that there should be a further reduction in the percentage increase and in the wagon hire charges. We are also strongly of opinion that charges at the docks for shipping and handling coal are excessive and should be immediately lowered."

Undetected Faults in Production Processes.

By A. WHITEHEAD.

To the man with a sound knowledge of the methods of production involved, the faults likely to be present in any given part, as the result of following a defined method of making it, will be obvious. He may be given only a drawing, together with a skeleton lay-out of the production processes; but this information will suffice for him to point out certain errors which must inevitably be present in some degree, as a natural consequence. Going deeper into it, he will require full details of every process and tool; and then he will be in a position to state what further defects may be found, and to indicate ways of improvement.

Knowledge of this kind, which covers a wide range, is uncommon; and as a consequence, the standard of accuracy attained is generally lower than most imagine. Especially is this the case when the production of sets of parts, the design of which remains practically unchanged, is not a prolonged experience enabling improvements to be made step by step. Although tolerances as applied to diameter have had considerable attention, the deeper aspects of errors in production have not. The conformation of component parts and the available methods of producing them vary so much, that it is an extremely difficult subject except in the most simple cases. It is an art, since individual judgment plays so great a part. No formula or recipe can be laid down to suit every occasion; but like other arts, it is based on definite technical principles.

Generally it is an excellent thing to be an optimist. A severe critic, a downright pessimist one should be in estimating the fruit of any production process, particularly when repetition work is concerned. When one or only a few of a kind are made, the conditions are usually quite different. The workman's skill is probably higher for one thing; but the principal difference is that any errors can be adjusted suitably, as a general rule, to render them of small account in the final result. The adjustment may be by actual correction, or by pairing parts having corresponding faults. With repetition work on a large scale, this method is too expensive to be profitable. Sometimes satisfactory production demands tolerances far finer than are necessary for the component to function properly in its place. Maybe certain features are used for jig location, and for that reason have to be correct within comparatively fine limits. Or it may be found cheaper to avoid scrap—through the cumulative error in a series of dimensions—by working very precisely, than to try to take advantage of the coarser limits prescribed on the drawing. For instance, some parts of the breech mechanism of a heavy gun are often made correct within a tolerance of 0.002in. in practically every detail, to restrain the final error at the end of a sequence of operations—locating from different faces—within safe bounds. The arrangement of the dimensions on a drawing may have a great effect on this. Some hold that there is little consideration required in fixing tolerances; you take a table of recommended standards, and there you are. That is the superficial view. When placing his dimension lines, the draughtsman is governed principally by the necessity for ensuring certain principal relations among the details of a component to ensure correct functioning. The minor parts are frequently dimensioned in a haphazard fashion. In arranging for production, these principal relations must be studied so that they do definitely result as nearly as possible; but they may be obtained indirectly, not immediately one from another, by the method of jigging or locating in fixtures; for it is not invariably convenient to work in a straightforward way. It follows from this that even in arranging the dimension lines, it is desirable to take into account workshop requirements, and to favour them when alternative dispositions are practicable. We may instance a familiar example—a four-throw crank shaft.

Giving the dimensions A B C D—Fig. 1—is quite nice for drawing-office use, but it is not satisfactory for the workshops, because the centre lines are not real. It is more convenient to measure E F G H. Now, if we require the accumulated error among B C D not to exceed 0.01in., the tolerance allowed on F G H must not be more than about 0.003in. on each. If, instead of the dimensions F G H we give the equivalent F K L, the tolerance can be increased to 0.095in. with the same result. This is a very tangible improvement, which is magnified with the number of links in the chain F G H. Easier production thus has been brought about very simply, without any expense other than that for the extra trouble in the drawing-office. When it is not common practice to specify limits on dimensions, and when they are not given individually—it being understood that the Newall or some other system is to be applied—the effect of cumulative errors is not so obvious. Yet it is present, and proper consideration of it, with suitable revision of the placing of dimension lines and tolerances modified in accordance, is well worth while. Done well, such revision may convert a small loss into a small profit by simplifying production.

It is convenient to state each dimension with its high and low limit. With the Newall system the number of decimal places—involving multiples of 0.00025in.—is cumbersome. If it is used, either the drawings are burdened with strings of figures, or reference to tables is continually necessary. The works may have a full equipment of gauges, but snap gauges are not so widely useful as micrometers. They test whether a diameter is between the limits or not, but they do not indicate the extent of the divergence outside them, and consequently can only be economically used when cutting tools will run for a long time without resetting to obtain the sizes desired. In most classes of work there are numerous places where they are unsuitable, for this or other reasons; and so a tolerance system which, in general, is confined to whole thousandths of an inch is frequently preferred. If the difference between the two ends of a limit gauge is, say, 0.003in., the full tolerance actually available is less, owing to the working clearance necessary for the "go" end; and the size generally arrived at will not be the arithmetical mean of the two ends. A hole will, on the average, be less than that, and a shaft greater. If a number of shafts are to be finished between the sizes 1.997in. and 2.000in., the majority are likely to be near 1.999in., with stragglers either side. But a number of holes to be finished between the same sizes would probably average about 1.998in. This is due to the workman's striving for safety; he tries to leave as much metal on as he possibly can, while endeavouring to obey the specification. The fineness of finish and process employed may modify these figures, but the tendency will remain.

Again, the skill of the workman affects his readings. The higher the skill, the more sensitive—as a rule—his feel with a gauge. Taking three men, one a highly skilled toolmaker practised in fine measurement, another a good mechanic not so expert in this way, and the third an intelligent man of semi-skilled rank, but accustomed to using a micrometer, one may expect their feel to vary in the following way, if each measured with a micrometer a plug measuring, say, 1.1226:—

The toolmaker's reading	1.1226
The mechanic's reading	1.1225
The semi-skilled man's reading	1.1223

To eliminate the difference in skill in reading the instrument each may simply set it on the plug, and hand it to a fourth person to note the figures. Then these figures indicate the degree of force which each considered should be applied. Of course, individuals of the same general skill vary very much in this respect; but, on the average, the differences shown are typical in amount and direction. And in using an ordinary snap gauge, the results will be similar; the less the skill, the greater the force exerted in gauging. It may be inferred, from the foregoing, that in repetition work employing a proportion of cheap labour, the fits between the shafts and holes will be very appreciably tighter than if the arithmetical mean sizes were worked to exactly, though there will be stragglers, of course. For instance, suppose the diameter of a shaft is to be within 0.999in. and 1.000in., and the diameter of the hole in which it fits between 1.000in. and 1.001in. The theoretical minimum clearance is nil, the maximum 0.002in. The mean—arithmetical—clearance is 0.001in. when the sizes are 0.9995in. and 1.0005in. But in practice the average shaft is likely to measure 0.9997in., and the average hole about 1.0004in., giving an actual average clearance of 0.0007in. We must not lose sight of the stragglers which are on the border lines between accepting and rejecting, nor of the effect of different methods of production. The tendency towards the effects quoted in the examples is, however, very powerful indeed; so it very seldom happens in pairing that the maximum theoretical clearance is obtained. This fact may be utilised to the employment of coarser tolerances than the theoretical mean clearance, or the greatest possible clearance, indicates as being desirable. And at the same time unwieldy decimals may be kept out, unless for a few exceptional cases. The unit 0.00025in. is easy to read on a micrometer, it is true; but once it is realised that the gauging feel of different men varies by more than that amount, and that the opposite ends of a limit gauge do not operate symmetrically as regards their effect on the size of the work, its frequent use in a tolerance system appears fussy rather than a practical necessity.

When tolerances and limit gauges began to be in common use, with plenty of jigs and special tools, many supposed that adjustments by hand to correct errors in machining would no longer be required. It was prophesied that the trades of fitting and erecting would soon almost vanish, being replaced by the mere assembling of parts sufficiently perfect from the machines. Considerable advance has been made, but except in certain classes of manufactures, to nothing like the anticipated extent. In common with so many erroneous ideas, the mistake lay in incomplete premises, not in the reasoning. In some cases, as the quality of the machine work became better, a more refined or more efficient functioning of the completed product was demanded. The amount of "navvying" in erecting was diminished, but fine adjustments were added, which absorbed nearly as much time.

But the great omission was the influence of defects in workmanship or processes which ordinary methods of inspection commonly neglect. Very large allowances for clearance can sometimes be given to prevent interference. Where this is impossible, either correcting processes must be employed, or the production methods and tools must be very refined. The design of the product must also be suitable. It need not necessarily be of extreme simplicity: very complicated looking parts can be made cheaply and well if the number of them is great enough to bear a large outlay on tools, and if they are such that the result from each process on them is definite, or can be made definite, with practical certainty, within narrow limits. These limits are frequently not those which refer to size: many are in respect of position or alignment.

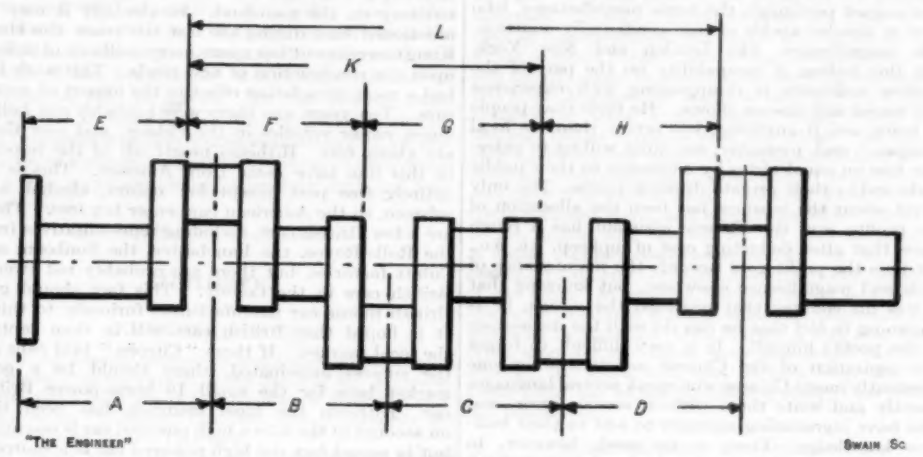


FIG. 1—FOUR-THROW CRANK SHAFT

The crank shaft indicated in the figure may be used to illustrate the class of defect referred to. The ordinary commercially produced four-throw crank shaft, as used in motor car engines, for instance, is from one point of view an excellent piece of work, and from another it is full of faults. It happens that it is very flexible, and the moving parts connected to it also tolerate considerable departures from the ideal, otherwise those faults would show more prominently. In practice they often go unnoticed unless very exaggerated, though they are bound to modify the running and life of an engine. We shall be right in mentioning the following faults as being some which are always more or less present in the ordinary four-throw crank shaft. It is understood that the shaft is to be suitably mounted so as to imitate its working conditions but without constraint except to bear its weight.

1. The main journals do not lie truly in one axis; there is excentricity or axial inclination present in some of them.

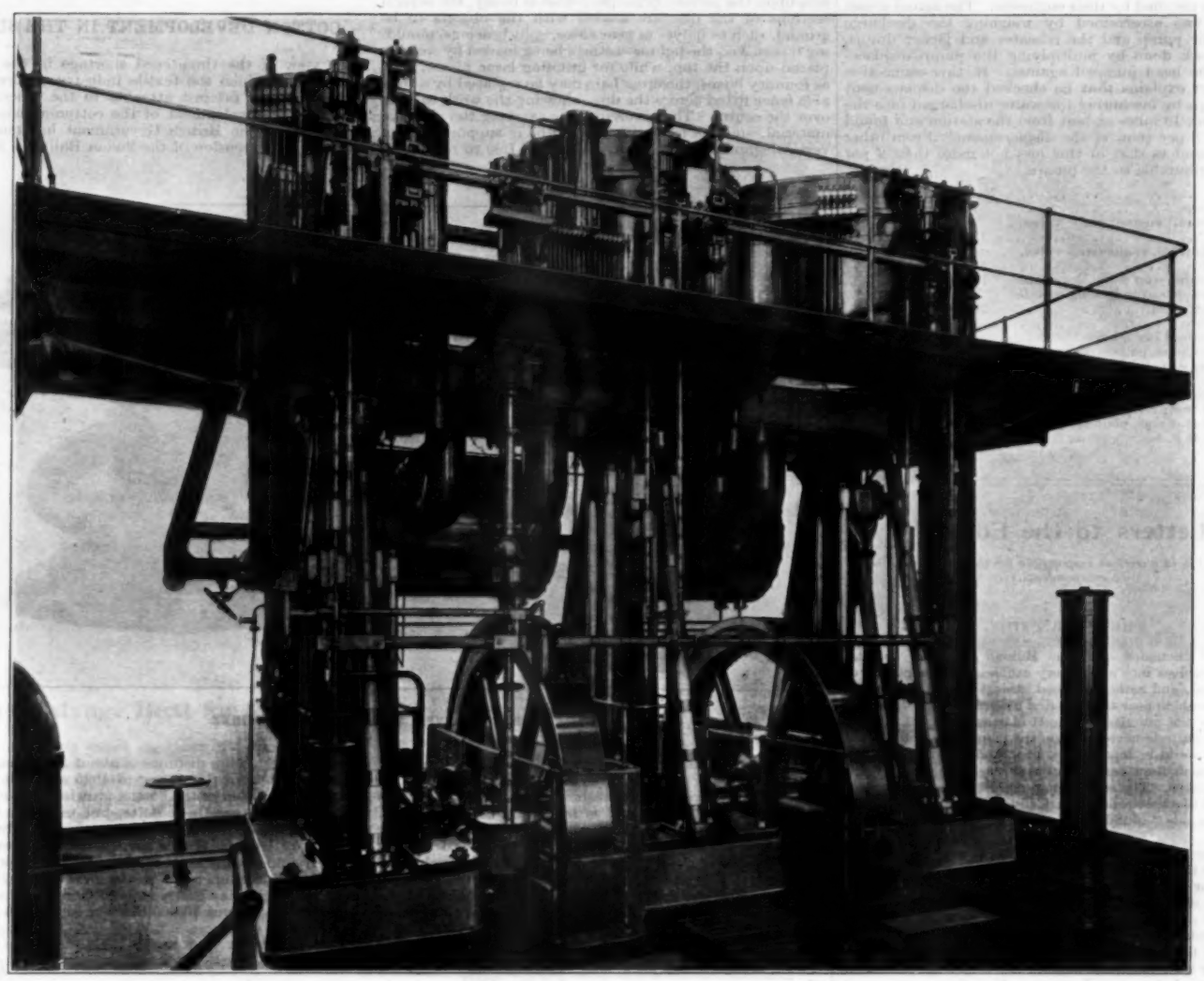
2. The axes of the crank pins are not all in one plane, nor do all of them lie parallel to or in the same plane as the principal axis.

3. The fly-wheel flange face is not square with the principal axis.

These few instances suffice for our purpose. Among them they include numerous faults, but only a small proportion of what can generally be found. It is arguable that since engines do run very well with such crank shafts, the matter is only of academic interest. But engines cannot usually be assembled without any fitting. Through these undetected faults arises the necessity for hand correction, and much of the difference in running of engines twin in every obvious respect of design and make. Far from being academic, it is of great practical moment to avoid them as much as possible. Shutting one's eyes to them does not render their presence less detrimental. Most can be restrained so that their

TRIPLE-EXPANSION THREE-THROW PUMPING ENGINE FOR AUSTRALIA

HATHORN, DAVEY AND CO., LIMITED, LEEDS, ENGINEERS



effects are negligible by a proper application of methods and tools. One good rule is to avoid all strains—of a measurable amount—set up by the clamping device, or means of chucking, during all the operations, and particularly when finishing. This is not always feasible. In the case of the crank shaft, the main journals and the flange face should be finished with it rotating freely without any end pressure along the axis. If it is run on centres, there must be end pressure and some yielding at each crank—not very much with care, but the amount depends on the workman's judgment, which is a variable unknown quantity. Therefore, make the process foolproof in this respect by eliminating the ordinary centres altogether. Due attention to this detail removes faults 1 and 3, or, at any rate, reduces to very minute amounts, providing the idea is applied throughout. It will not suffice to refine the final operations of grinding alone, for to some extent the grinding will copy original deformations present when it is commenced. Again, this copying action can be minimised by the workman's skill in setting his steadies and applying the wheel; but that is inconstant and, therefore, unsuited for the degree of accuracy aimed at. Grinding the crank pins should be on the same lines, and then the errors 1, 2, and 3 will all be small if the methods throughout production are equally sound.

The cost of a crank shaft thus made will be about the same as if coarser methods were used. The total cost, including fitting, will be less for good results, and not more than if excessive clearances are provided as in inferior work. Accurate machine work is seldom more expensive than rough imitations of it, if the ways of doing it are mechanically sound. On the whole, it is undoubtedly cheaper because it saves undesirable after effects.

The feasibility of inspecting components regularly, to discover and measure faults of the kind indicated, needs little consideration—it would be enormously expensive. But occasional thorough search, taking one piece at a time, and making a systematic report on every dimension, and each relation which is stated definitely or implied on the drawing of it, reveals many surprising, even horrifying facts. The report may be conveniently made on a standardised sheet or a blue-print of the piece examined may be used for the results to be noted. It is desirable to measure each surface at several points: for instance, a journal should have its diameter checked at different parts of its length to ascertain taper, and at different angles to find how much it is out of round. It is one thing to think "we work to a thousandth part of an inch" because we possess a grinding machine and a micrometer, and quite another to get—in effect—even near it.

There is an indirect verification of this known to all who have experienced trying to assemble components made by several contractors to drawings and specifications supplied by those who do the assembling. Unless the clearances and margins are large there is always trouble. The number of different ways a drawing can be understood—or misunderstood—is surprising. What is obvious to those who produced it and by them understood—by implication, or tradition, or a complete knowledge of the functioning of the part in relation to other parts—may be entirely missed by the sub-contractor. He is not informed probably, because it strikes no one that it can be necessary. To take a simple case, suppose a quantity of very short tubes was required, it being essential that the inner and outer cylinders were truly concentric. There might be a note on the drawing to that effect, but probably not, for this is just one of those items which get established in a works by tradition. The sub-contractor very likely has his first sample passed. But it by no means follows that that is typical of the rest. It is, perhaps, a turret lathe or automatic job, and he certainly will not set up either for making a sample, nor let a machine stand for a week awaiting the report on it. No, his object would be to make a sample quickly and cheaply on some other machine—perhaps in his tool room—as a matter of form, or to make sure that there was no quarrelling with standards as regards dimensions. It is passed; he begins production and finds later a great proportion of his deliveries is scrap. The drawing is nicely symmetrical, but nobody told him such symmetry was essential; and he turns the outside, drills the holes, follows with a reamer, and naturally, therefore, as the drill sometimes ran ex-centrically, so do the finished holes. Of course, his work is not to drawing strictly. But convention tolerates some liberty in a case like this, as a rule.

When stiff castings are machined, the handling of them is generally correspondingly robust. It is difficult to treat them so that large finished surfaces are free from "twist" or "wind"—occasionally almost impossible at a low cost. A three-point support is useful, but does not always answer, however careful the clamping during machining. Stiff in certain directions, they are often easily deflected in others despite the amount of metal in them. Their own weight on differently distributed supports may suffice appreciably to upset a surface near enough flat when supported in another not very different way. And if an apparently stiff casting is so easily deflected, it is easy to understand how nice methods of production must be to obtain first-class results and how unusual it is to find them. But without doubt, in the long run, the most economical methods are those designed and applied with the greatest nicety of mechanics.

Tests of Three-Throw Pump.

AMONG the pumping plants recently sent to Australia by Hathorn, Davey and Co., Limited, of Leeds, there is the engine shown in the accompanying engraving, which has been supplied, through the makers' Sydney agents, Messrs. Frank Saunders, for the Umberumberka pumping station of the Broken Hill water supply on the western border of New South Wales. The station is at an altitude of some 900ft. above sea level, which largely accounts for the comparatively low vacuum registered during the trials, of which we give the results below.

The engine, it will be seen, is of the vertical triple-expansion type, with an open marine style of front. The cylinders are 16in., 28in., and 46in. in diameter by 3ft. stroke, while the pumps, which are of the single-acting plunger type, are 11¾in. in diameter. The pumps are arranged in the basement directly below the engine, and the plungers are each directly connected with the crossheads above by means of the four rods that can be seen in the illustration. This arrangement naturally gives an extremely high mechanical efficiency, as the only work which passes through the connecting-rods and crank shaft is the comparatively small amount required to operate the valves and to compensate for inequalities in pressure due to the expansive use of the steam. The steam valves are of the Corliss type operated by the makers' standard gear, which, with a minimum number of parts, gives an excellent steam admission and a very sharp cut-off.

Steam is supplied by two Babcock and Wilcox boilers, each having 1619 square feet of heating surface and suitable for a working pressure of 180 lb. Only one boiler

is required for steaming the plant, the other boiler being a spare. It should be noted that both the boiler feed pump and the air pump are driven from the main engine so that no allowance for additional steam required by them has to be made.

The official Government trials referred to above were made by the purchasers, and the results, which we give below, were certified by their engineers. The actual steam consumed was ascertained by weighing the discharge from the air pump and the reheater and jacket drains, and the work done by multiplying the pump displacement by the head pumped against. In this connection the engineer explains that he checked the displacement of the pumps by measuring the water discharged into the delivery tank 18 miles distant from the station and found a loss of 3.8 per cent. of the displacement. From other data he considers that of this loss not more than 2 per cent. is attributable to the pumps.

Test	No. 1	No. 2
Duration, hours	10	10
Steam pressure, engine stop valve, pounds	173.1	172.3
Steam temperature, engine stop valve, deg. Fah.	522	518.7
Superheat, engine stop valve, deg. Fah.	145.3	142.4
Feed water temperature leaving economiser, deg. Fah	200.7	193.4
Vacuum, inches	26.6	26.5
Speed, revolutions per minute	38.47	38.95
Water displacement, gallons per minute	1626	1646
Net head, feet	489.8	528.5
P.H.P.	241.33	263.6
Steam consumption in 10 hours as weighed from air pump discharge and jacket drains, pounds	25,524	28,083
Steam per P.H.P. hour, pounds	10.58	10.65

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE HUMAN SIDE.

SIR,—The discussion of "The Human Side" of industry inevitably resolves into a desultory exchange of complaints on the one hand, and rather strained ethical aspirations on the other. It would appear that the first essential of the discussion is to eschew the practical methods of reasoning and adopt a sentimental attitude never used on the plane on which the real work of the world is done. This, I am persuaded, is the chief reason why such discussions peter out inconclusively, and, moreover, is mistaken. The engineering method of considering and collating all the known data is equally essential in considering the "human side" of industry, as in perfecting an engineering design.

The growing criticism of industry is occasioned by the indisputable fact that it is falling short of its promise in providing a livelihood for the community as a whole. It is not a criticism confined to either employers or employed. The one finds it increasingly difficult to make ends meet and then live, while the latter finds it increasingly difficult to secure regular employment. The final result is that employers are anxious to find openings for their enterprise abroad, and large-scale emigration of employees is being seriously mooted. Now, from an engineer's point of view, this is the wrong result of centuries of improvement of industrial method and technique in applying the vast resources of Nature for the use and convenience of man. The natural effect of the continuous lengthening of the industrial lever, one would suppose, is that the work of the world would be done with ever-increasing ease, and, as a consequence, the mode of living of each individual in the community would be continuously enhanced. Instead, on the contrary, neither the owners of the machine nor the operatives, despite their urgent desires, can make that machine work so that it shall "deliver the goods"—the only conceivable reason for its construction. The problem, in short, is not how to produce, but how to effect the distribution of the product of industry at an adequate rate.

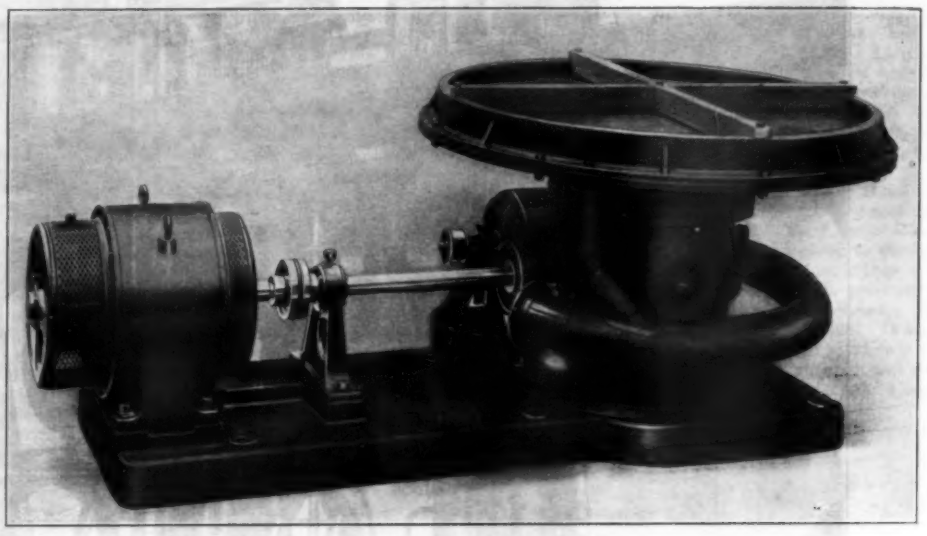
It is precisely this problem to which the engineers' method has been applied by Major C. H. Douglas, M.I.M.E., with results which must be profoundly disturbing to the protagonists of either the capital or labour schools. A critical examination of the known factors of the industrial process, particularly finance, shows that the defect resides not in any human obliquity, but in the fact that the total incomes received by the public, *i.e.*, wages, salaries and dividends, &c., are increasingly unable to buy back the product of those incomes at the minimum price which must be charged to recover costs. In other words, that the rate of production is necessarily and to an increasing extent greater than the rate of delivery, and that, in consequence, the industrial machine, considered as a pump, is choked. Such being the case, the problem resolves itself into the essentially practical one of adjusting the operation of the machine to ensure that at all times the rate at which the public can acquire goods and services shall be at least equal to the rate at which those goods and services can be produced by the industrial machine. Major Douglas projects a remedy which involves a slight modification of the method of financing industry. His remedy may not be right—*i.e.*, the desirable—one, but it will be apparent to all engineers that the problem is one after their own hearts, and that its solution may not be the least of the conquests achieved by the application of engineering principles.

January 10th. ARGON.

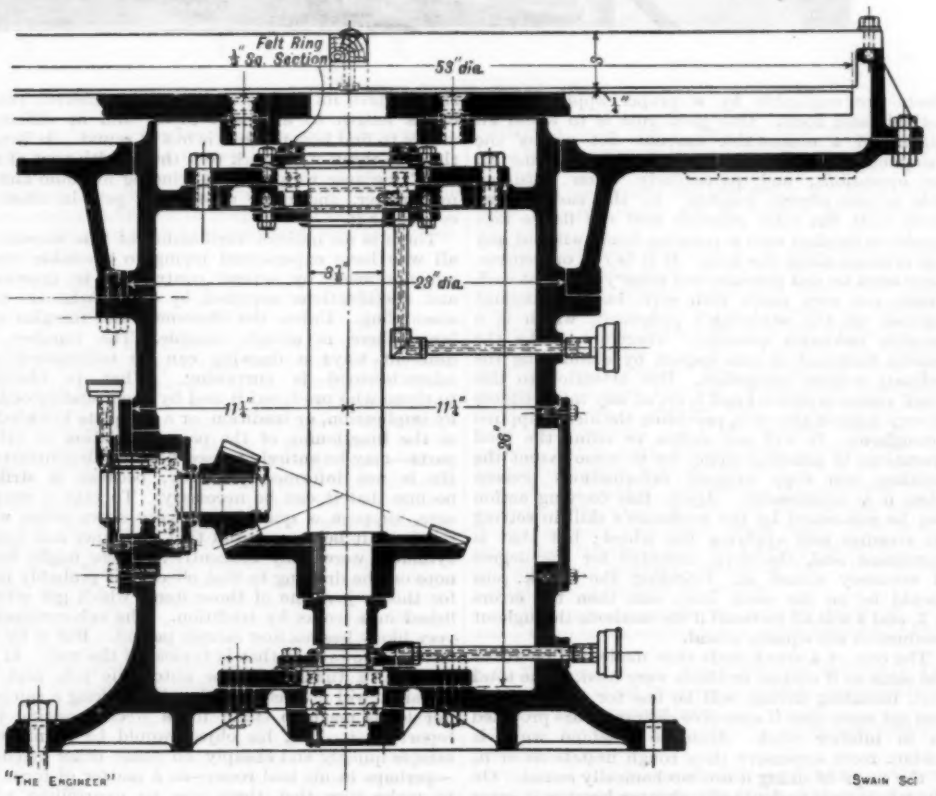
CASTINGS furnished for evaporators and pans may sometimes be porous in spots, and when such castings are supplied, states the *International Sugar Journal*, the factory engineer will be surprised to observe how much better after a painting process the vacuum will hold up, only a very slight leak sufficing to reduce it quite considerably. After the erection of an evaporator or pan, before the lagging is put on, the bodies and piping should be covered with a thin mixture of paint while the apparatus stands under vacuum. Every stroke of the brush should be watched by the painter, so that he may detect pin holes and defective joints. These leaks should be painted and repainted, allowing each successive coat to dry, until the apparatus is entirely air-tight.

Horizontal Disc Grinding Machine.

A USEFUL type of horizontal disc grinder for working upon articles which cannot conveniently be dealt with on ordinary disc grinders is illustrated herewith. The machine acts upon the gravity principle; that is to say, the several sections of the disc are loaded with the objects to be ground, such as halves of gear cases, split bearings, moulding boxes, &c., the lighter castings being loaded by weights placed upon the top, while for grinding large pieces, such as foundry boxes, the cross bars may be replaced by a suitable fence fitted across the disc, allowing the work to span over the centre. The revolving disc carrying the abrasive material, such as carborundum cloth, is supported on a vertical spindle which is carried by and free to revolve in ball and roller bearings, as shown in the sectional drawing. On the spindle is a spiral bevel wheel with which a pinion on the main driving shaft meshes. The disc is 53in. diameter and 1¼in. thick, and is machined to close limits. Both faces of the disc are spirally grooved for the better adhesion of the emery cloth circles. The shaft is driven by a 13 horse-power electric motor running at 1150 revolutions per minute, a flexible coupling being interposed between the motor and the shaft. The motor, the bracket and the base of the machine are all mounted upon a substantial bed-plate, together with an exhauster which is driven by means of a belt from the shaft which drives the vertical spindle. This exhauster draws the dust given off in the grinding process from under the disc by means of two suitably designed passages provided in the table. The table has bolted to it an annular cast iron ring to which the fence for keeping the castings in place is secured. All the roller bearings throughout the machine are fitted with grease lubrication and the steel disc to which the emery is attached is provided with tapped holes to receive eyebolts for removal when required. When the machine can be stopped for some hours at a time, no spare steel disc is required and a pair of half-press plates is supplied so that the renewal of the emery circles can be made without removing the disc from the spindle. The machine is made by Cunliffe and Croom, Limited, Manchester.



GRAVITY TYPE DISC GRINDING MACHINE



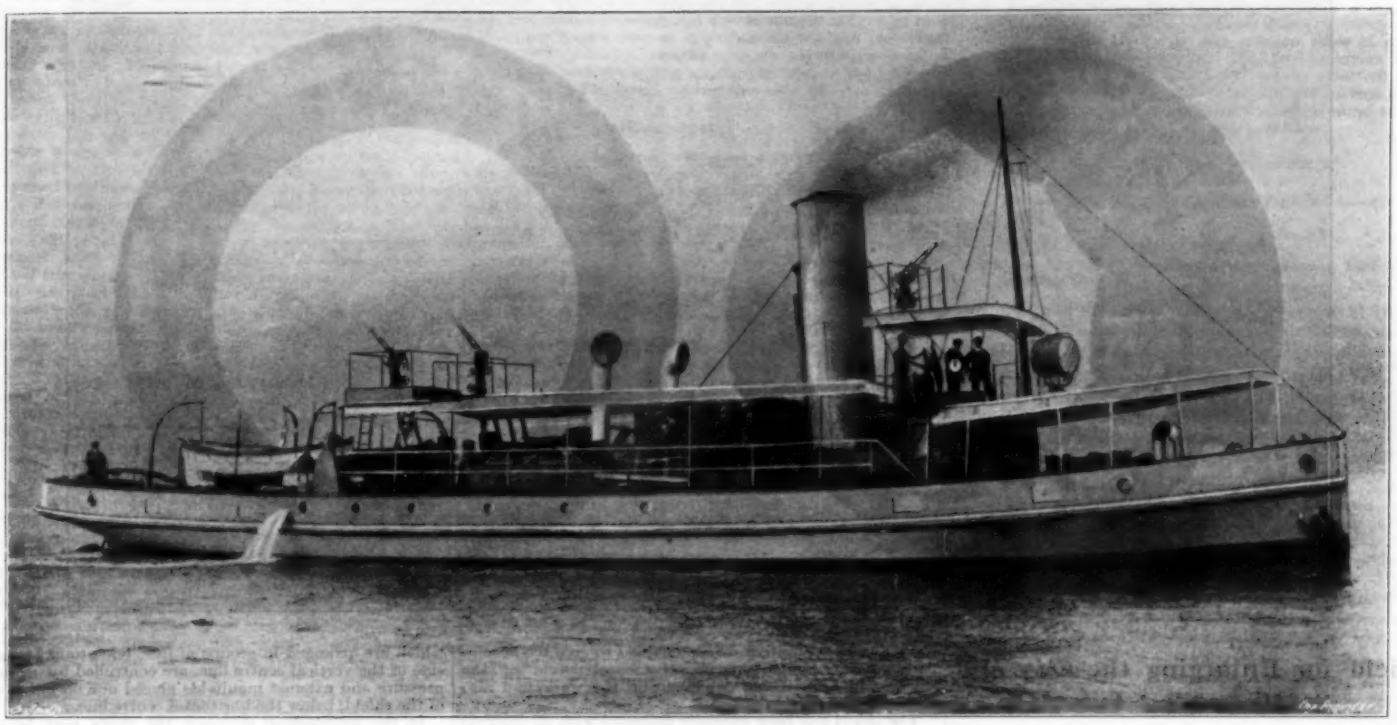
VERTICAL SECTION THROUGH DISC GRINDING MACHINE

COTTON DEVELOPMENT IN THE SUDAN.

IN view of the threatened shortage in the supply of cotton with which the textile industry of Great Britain is faced, much interest attaches to the scheme now on foot for the development of the cotton-growing areas in the Sudan. The British Government has guaranteed a loan for the extension of the Sudan Railways to Kassala, in Eastern Sudan, a distance of about 217 miles. This line will be opened in the spring of 1925 and will permit not only an expansion of the cotton-growing area in the fertile region of the river Gash delta, but will open up Eastern Sudan for the export of cereals, cattle, &c. Owing to lack of railway transport, this rich district has been hitherto entirely undeveloped. It is anticipated that within a few years after the opening of the new railway it will be possible to grow as much as 100,000 acres of cotton each year, yielding about 40,000 bales of cotton. A loan is also to be raised for the irrigation and development of a large cotton growing area in the Gezira district south of Khartoum. The area to be developed is 300,000 acres, of which 100,000 acres will be under cotton every year. The necessary work should be accomplished in time for the planting of the cotton crop in 1925. The area is expected to produce about 70,000 bales of long staple Egyptian cotton annually. This scheme is capable of vast development, as may be judged from the fact that there are some 3,000,000 acres in the Gezira district which are suitable for growing cotton.

FIRE AND SALVAGE BOAT FOR RANGOON

MERRYWEATHER AND SONS, LIMITED, GREENWICH, ENGINEERS



Fire and Salvage Boat for Rangoon.

THE fine sea-going vessel shown in the above illustration has recently been constructed by Merryweather and Sons, of Greenwich, for the port authorities of Rangoon, to act primarily as a fire and salvage boat, but also to be available as a tug and water tender. She has been built under Lloyd's survey and is classed A1 for river and harbour service. The overall length is 109ft. 6in., the beam 20ft., and the depth 8ft. 6in., while she draws 6ft. 6in. of water. There are five water-tight bulkheads, the hull being divided into nine compartments, viz., fore peak for water ballast, chain locker, fore cabin, fresh-water tank, boiler compartment, engine and pump-room, fresh-water tank, hold, aft peak for water ballast.

The main propelling machinery comprises twin-screw sets of triple-expansion engines with cylinders 10in., 17in., and 26½in. in diameter by 16in. stroke, capable of indicating 800 horse-power and supplied with steam at a pressure of 200 lb. per square inch by an oil-fired Yarrow boiler having an evaporative capacity of 18,000 lb. per hour. There are three high-pressure atomising burners, to which the fuel oil is supplied by direct-acting steam pumps in duplicate, having arrangements for operation by hand when lighting up. A very complete system for heating and filtering the oil is provided, and air to the furnace is supplied through a trunk under the boiler-room floor by a fan driven by a high-speed steam engine. The oil fuel tanks, which are arranged one on each side of the boiler, have a capacity of about 13 tons of oil. There are two direct-acting single-cylinder feed pumps, one in the engine-room taking its supply from an automatic hotwell and the other in the boiler-room.

The two salvage and fire pumps are of the Merryweather double-cylinder double-acting vertical "Greenwich" type and have a total pumping capacity of 4000 gallons per minute, while they are capable of working at a delivery pressure of 150 lb. per square inch. A powerful single jet 3½in. diameter can be discharged to a height of 200ft., whilst no less than twenty-four jets can be thrown simultaneously if desired. Each pump takes its supply for fire purposes through a strainer box and full-way sluice valve fixed to the ship's side below the water line, and for salvage work through a pipe leading to deck level, where two multiple suction heads are fitted, each having four separate connections for 6in. salvage suction piping. The pumps are entirely of gun-metal with india-rubber disc valves and copper air vessels.

The exhaust steam from the propelling engines, pumps and auxiliaries is dealt with by an independent condensing set having a single cylinder vertical steam engine driving an air pump by rocking levers from the crank shaft and a centrifugal circulating pump directly coupled on to the crank shaft.

A complete electric lighting equipment is provided, the power being taken from a steam-driven compound-wound dynamo rated for an output of 90 ampères at 100 volts. A full set of electric navigating lights is fitted, with all necessary lamps and fittings in the cabins, engine-room, &c., together with a 24in. electric searchlight projector.

The fire-fighting equipment comprises three double swivelling monitors, which can be seen in the engraving, one fixed over the navigating platform and two fixed aft on platforms above the awning level. On deck there are two delivery heads, each having six full-way valves for the attachment of delivery hose. Two thousand feet of canvas delivery hose is included for use with the fire pumps, whilst 480ft. of 6in. diameter flexible india-rubber suction hose is provided for salvage operations. The two fresh-water tanks have a capacity of 5000 gallons, and a separate high-speed "Valiant" steam pump has been provided for dealing with the tank supply.

Ample cabin accommodation is provided for the master, engineer and native crew, and the ventilation arrangements are very complete, including cowl head and mushroom ventilators and electric fans. The boiler-room casing is bolted together in sections, so as to be easily convertible into an open fiddley on arrival in Rangoon. Permanent awnings are provided at the forward end of the vessel, bridge deck and after end of the engine-room, but in the aft part of the vessel a portable awning is provided that can be removed when towing duty is in progress.

The speed trials were carried out in Sea Reach under the worst possible weather conditions, a heavy gale blowing with a deluge of rain, but a mean speed of 13.18 knots was nevertheless obtained over several runs on the measured mile. This speed is 1.7 knots over the contract speed, and even it was improved upon by a run up and down the Long Reach measured mile, which we timed and found to work out at 13.32 knots. Pumping tests of considerable duration were made alongside Greenwich Pier, the three monitors being brought into operation simultaneously, each with nozzles of 2½in. diameter. A test was also made with twelve jets, each 1¼in. diameter, delivering simultaneously through lines of hose from the deck delivery valves.

On the completion of the official tests the vessel was prepared for her voyage overseas under her own steam and equipped throughout to comply with Board of Trade regulations. The whole of the awning and supporting stanchions were removed and extra fuel oil tanks were installed in the space occupied by the pumps, which were removed and dispatched separately. A stout timber structure was built forward to keep the decks as dry as possible in a heavy sea, and at the time of writing we hear that the vessel is well on her way to the East.

ENGINEERING STANDARDS ASSOCIATION, AUSTRALIA.

THE main committee of the Commonwealth Engineering Standards Association of Australia has now been appointed. The Association was recently formed for the purpose of co-operating with the Commonwealth Institute of Science and Industry in the preparation of specifications, &c., for use in the Commonwealth of Australia.

The functions of the main committee will be: To decide what standardisation work shall be undertaken; to appoint members of the sectional committees or panels, to which the work of preparing specifications will be entrusted; to arrange for the carrying out of research work on the recommendations of the sectional committees; to receive and deal with the reports and recommendations of sectional committees; to arrange for the publication of the specifications through a standing committee; to keep in touch with "engineering standards" organisations in other countries; to control finance through a standing committee; to control the secretarial staff of the Association.

The following gentlemen have been appointed to the main committee.

Nominated by the Institute of Science and Industry.—Messrs. G. H. Knibbs, C.M.G., Director of the Institute of Science and Industry; Mr. Norris G. Bell, Commissioner, Commonwealth Railways, Melbourne; and Colonel P. T. Owen, who is Director-General of the Federal Works, Melbourne.

Nominated by the State Governments.—New South Wales: Mr. A. D. J. Forster, Assistant Chief Mechanical Engineer, New South Wales Government Railways, Melbourne. Victoria: Mr. E. H. Ballard, Chief Engineer of Way and Works, Victorian Government Railways, Melbourne. Queensland: Professor R. W. H. Hawken, Professor of Engineering, University of Queensland, Brisbane. South Australia: Mr. F. W. Stephen, Chief Engineer for Railways, South Australian Government, Adelaide. Tasmania: Mr. J. H. Butters, General Manager, State Hydro-Electric Department, Tasmania. Western Australia: Not yet nominated.

Nominated by the Institute of Engineers, Australia.—Professor W. H. Warren, Dean of the Faculty of Engineering, University of Sydney; Messrs. J. J. C. Bradfield, Chief Engineer for Metropolitan Railway Construction, New South Wales Government, Sydney; G. A. Julius, Consulting Engineer, Sydney; O. W. Brain, Chief Electrical Engineer, New South Wales Government Railways and Tramways, Sydney; A. J. Gibson; and Senator J. D. Millen, Minister for Repatriation, Commonwealth Government.

Nominated by the Institute of Mining and Metallurgy.—Messrs. W. E. Wainwright; G. H. Blakemore; and F. D. Power, Consulting Engineer and Lecturer on Mining at the University of Sydney.

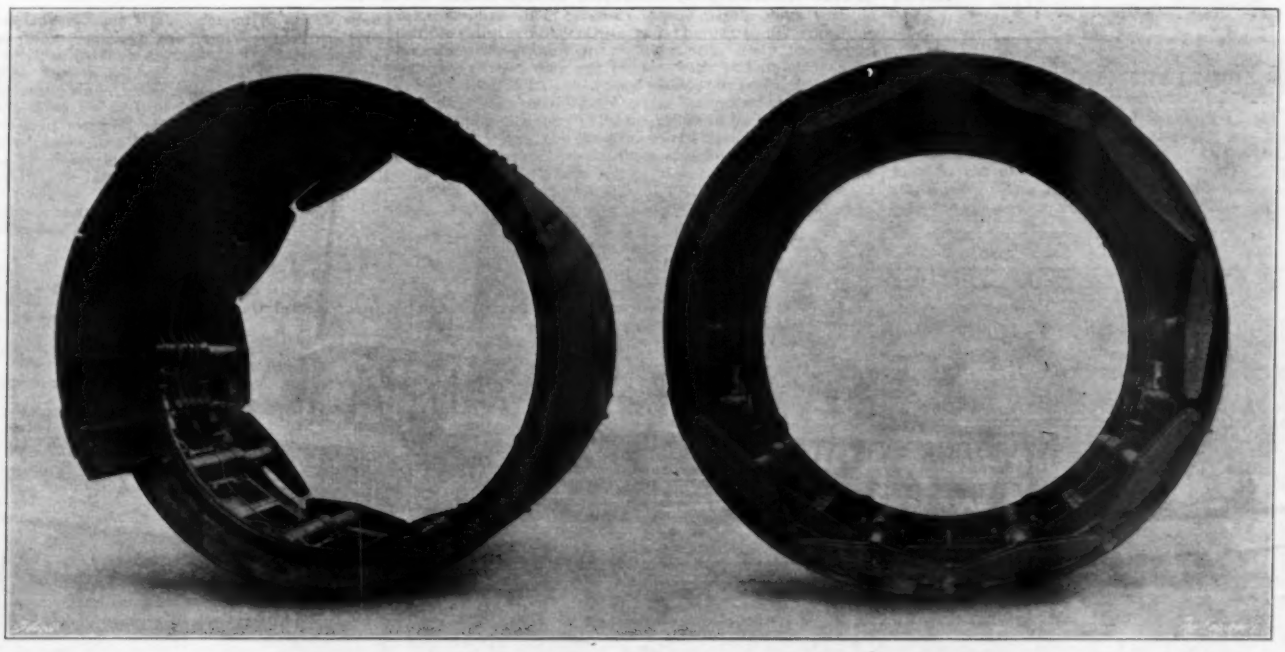
Representatives of the Australian Chemical Institute.—Messrs. A. E. Leighton, Controller-General of Munitions, Department of Defence, Melbourne; R. H. Walton, Chief Chemist, New South Wales Government Railways, Sydney; and H. Tindale, Chief Chemist, Australian Gaslight Company, Sydney.

BRITISH TRADE WITH CHINA.

VALUES, says Reuter's agent in Shanghai, only can be taken to gauge the extent of the machinery and engineering trade; but as the ratio of exchange in China as between the foreign Powers has not differed to any appreciable extent, values can be taken as an indication and approximation of the trade done, even if they are not minutely accurate. Taking values, therefore, in the seven items which cover the machinery trade with China, viz., machine tools, agricultural, propelling, textile, brewing, other kinds of machinery and electrical material and fittings, Great Britain in 1921 held the lead in four, came second once and third twice. America held the lead twice, came second four times and third once. Taking the same in percentages, Great Britain in 1921 held 35.87 per cent. of the machinery trade; America, 31.20; Japan, 15.12; and Germany, 2.12. America's figures show a considerable decrease over 1920, Great Britain's a considerable increase. Now, though figures are not available for the whole of China, Great Britain's imports of machinery into Shanghai for the first nine months of last year, based; on value, were 52.29 per cent.; America, 25.68 per cent. Japan, 9.29 per cent.; Germany, 7.49 per cent. These figures, though they can only be taken as approximate, nevertheless are a fairly reliable indication of the trade of China—in which Hong Kong is not taken into account—and show the re-establishment of British prestige. It must not be forgotten, however, in considering this market, that Germany is increasing her business, and noticeably in electrical power plants, for which there is a growing demand, and in electrical goods. She is helped to a considerable extent by the favourable exchange, though German merchants in China are reluctant to quote in marks, preferring sterling or the American dollar. Nevertheless, it is a competition which is advancing, and one in which the British manufacturer could do much more than he is doing if he were able always to compete in price.

A CHINESE promoter proposes to start metal mining in Szechuen with capital subscribed by foreign-born Chinese. He has sent his projects to the officials of the province, and will start his undertaking after they have been passed by the Provincial Assembly. He also intends to build 2000 miles of railway, but before the construction of the railway he will commence the mining of gold and other metal. The first section of his proposed railway is to be Cheng-yu, between Chengtu and Yu-chow. The capital of this proposed company is to be about 130,000,000 dollars.

SHIELD FOR ENLARGING THE CITY AND SOUTH LONDON TUBE

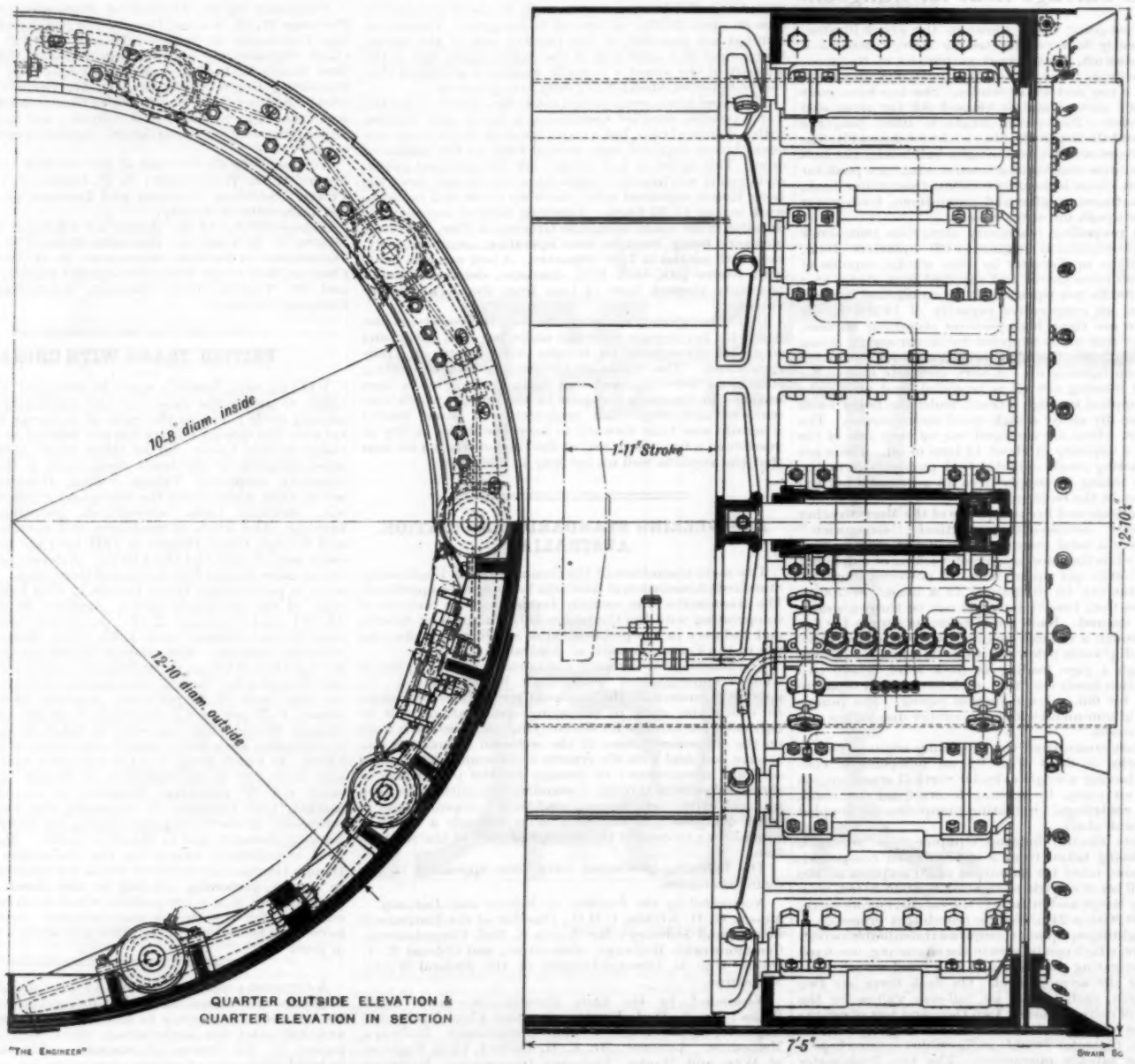


Shield for Enlarging the City and South London Tube.

OUR readers will remember that the operation of enlarging the diameter of the City and South London tube is now being carried out. The method adopted was illustrated and described in our issue of November 18th, 1921, and through the courtesy of their makers, Sir William Arrol and Co., Limited, we are enabled to give the accompanying engravings showing the construction of the shields which are being employed on the work, and also the following particulars.

The shield has been specially designed with an internal diameter of 10ft. 8in., to allow the existing railway traffic to pass through while it is in place. The external diameter being 12ft. 10in., the shield in end elevation has the form of an annulus 13in. wide, with the ten operating rams equally spaced round the circle. These operating rams, which are arranged in groups of five, one group on either side of the vertical centre line, are controlled by means of pressure and exhaust manifolds placed one on either side of the shield, below the horizontal centre line.

In the longitudinal direction the shield may be considered as being in three portions, viz.:—The cutting edge, the centre portion containing the operating rams, and the tail portion where the tunnel ring segments are built. Its overall length is 7ft. 5in. In the front is a heavy cast steel ring in three segments which forms the cutting



ARRANGEMENT OF SHIELD AND HYDRAULIC OPERATING RAMS

edge. This ring, which has been specially constructed for protection when working in gravelly ground, is securely bolted to the skin plates, and also through two mild steel packing plate rings immediately behind it to the front flange of the centre portion. The packing rings between the cutting edge and the centre portion are made in five segments each, and are arranged to "break-joint" with each other, and also with the cutting edge and the centre portion. The centre portion, which is a heavy ring of cast iron in five segments, is strongly ribbed and bolted. It forms the foundation ring for attaching the operating ram cylinders to, and is fitted with a narrow parallel key piece on the top to facilitate dismantling. The centre portion is also attached to the skin plates by bolts having the nuts to the inside. The tail portion of the shield is formed by the mild steel skin plating being carried back for a distance and forming a chamber in which the permanent tunnel ring segments can be erected in position. This portion is provided with adjustable packings so arranged as to facilitate the aligning and erection of the tunnel segments. The operating rams are each furnished with cast steel crossheads having spherical seatings for the ram ends, to allow them to accommodate 2 deg. out of line in any direction. The rams are made of forged steel and the cylinders of cast steel with gun-metal liners, fitted with U leather packing rings, and hydraulic drawback. Each ram may be independently controlled by means of the small valves arranged on the pressure manifold, while by means of the larger valves at the corners of the manifold they may be opened to either pressure or exhaust as required. The working stroke of 1ft. 11in. allows of one complete tunnel ring being built up at a time for each stroke of the rams. All the outside surface of the shield is smooth, all the bolts being countersunk on the outside. The butt straps, being on the outside, act as guides to keep the shield on a level keel. The whole shield is built in such a manner that it can be completely dismantled without necessitating a special chamber for this purpose. The hydraulic working pressure is 1800 lb. per square inch, at which pressure each ram is capable of exerting a push of 30 tons, making a total push on the shield of 300 tons. All parts subjected to hydraulic pressure were tested to 2 tons per square inch.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Iron Trade Revival—Advanced Prices.

THERE is increasing faith amongst iron and steel masters in Staffordshire and the Midlands that business is at last on the up grade, and the signs of a trade revival which made themselves evident at last week's quarterly meeting are favourably interpreted by industrialists of wide experience. The forward movement has continued through this week, and there has been bolder buying of raw material against future requirements. So much so that producers have had little difficulty in securing enhanced prices for their products. There has been more animation than at any time since the ill-fated boom. The opening of the new quarter has been heralded by bounding prices in various directions, and iron, both raw and manufactured, steel and sheets are dearer. Values began to recover in December last. With the turn of the year there has been a sudden quickening of the upward movement. This week prices appreciably higher than the advanced rates that ruled on the Birmingham Exchange last Thursday are being demanded. But the market has not lost its head. There are moderating influences at work to keep price movements within bounds. It is evident that trade recovery can have no element of permanence as long as discord and chaos reign over the greater part of Europe. Foreign competition will necessarily weigh with producers in estimating how far an increase of selling prices is consistent with an increased volume of trade. Just at present the British producer is less harassed by outside competition than he was recently. The lack of coke is likely still further to repress continental competition. There is an increased demand on both home and foreign account for industrial fuel, and this is aggravating the difficulties of British iron and steel masters, who find the prices put up against them as a consequence. Indeed, there is some fear of a fuel shortage in the near future, and producers of iron and steel are no doubt bearing this in mind when quoting for forward business. A large number of orders have been booked in some departments, billets being an example. The considerable price advances which have been effected convey perhaps an exaggerated view of the actual improvement in the trade situation. The balance of supply and demand has been temporarily upset in several branches of the market by the rush to cover commitments and to strengthen stocks. Behind this there is the contingency of a sudden strain being thrown on home production by complications on the Continent. Ironmasters do not care in the circumstances to pledge their output too far forward. They protect themselves by raising the price. This upward turn of prices is causing some apprehension. Undeniably it has stimulated buying. Industrial consumers are anxious to cover the commitments into which they have entered. There is more forward business than for a long time past. Recognition of the recent trading losses of important iron and steel concerns brought about by their endeavours to meet buyers is a stabilising influence at this period.

Orders Rushing In.

Values of manufactured iron have appreciated, and orders are now rushing in to the Staffordshire mills in a manner which causes satisfaction. No alteration has been made in marked bar prices, which have remained firm at £13 10s. since April of last year. Makers are finding increased orders for a variety of high-class work, but for the time being they are content to let well alone. Staffordshire Crown bars have, however, advanced by fully 5s. per ton, to-day's price varying from £10 15s. to £11. It is stated that in some cases as much as £11 5s. has been obtained by makers of good class merchant bars. Lancashire houses quote £11 10s. Carriage to this district involves an addition of something like 15s. or 16s., so that makers can hardly hope to compete with Staffordshire houses. Nut and bolt bars are also dearer, £10 being asked by Lancashire firms against £9 15s. a week ago. The mills there are busier than at any time for the last two years, and Staffordshire producers who are not quite so well off in this respect are selling a little cheaper, to the extent of probably half-a-crown, or in rare cases 5s.

Steel Market Excitement.

This week has witnessed a little flutter of excitement over semi-finished steel, for which as high as £8 2s. 6d. has been quoted. The recognised figure for this material a week ago was £7 7s. 6d. Brisk inquiry for material led to price advances, and although the figure quoted above is generally considered somewhat inflated, it has been paid by consumers in immediate need of material. Indeed, demand for billets has developed such strength in spite of the stiffening of prices that some of the Welsh mills are stated to have sold their output as far as they are prepared to go. Considerable sales of soft billets have been effected at £8, which would appear to be the market value at date. Finished steel is dearer in most departments. Staffordshire makers have advised their customers of an advance of 10s. on plates, and of 5s. on joists, angles and sections. The increase will apply also to tube, strip and other similar material. The re-rolling mills are quite busy providing material for bedstead and tube making, and for various stamping purposes. The Midland steel works are getting their share of the improvement, and there is an increased demand for structural steel. A fair amount of new business has been done on the basis of the enhanced prices announced last week. Railway steel is in good demand, and some excellent orders have been placed with local works. A very large order for steel tires has found its way to Wednesbury, and is understood to be for the equipment of an Indian railway. The activity in wagon building has brought some business to Staffordshire works, and certain firms have enough work to keep them employed until May next. The market is somewhat disturbed by the French move in the Ruhr district. For the present it is assumed that British steel makers are likely to gain a little advantage through the reduction of competition. In some instances English buyers have received intimation that deliveries of semi-finished steel under existing contracts cannot be depended upon, and in other cases undertakings have been cancelled. English consumers are more inclined at the moment to rely upon native steelworks for their supplies, and this has strengthened a market already firm. Steel scrap has become scarce and dear, sales having been made at as high as £4 5s. for material selling two months since at about £3.

Pig Iron Optimism.

There is an air of hopeful optimism in Midland raw iron circles. For six months past pig iron producers have been trying to get prices made commensurate with manufacturing costs. Notwithstanding the increased exactions of the coke suppliers, blast-furnace owners were unable until quite recently to move the market. Many of them, indeed, had to accept prices much below those nominally ruling in order to get rid of their output. Latterly their position has been strengthened appreciably. With a hardening market consumers are coming forward with orders, wishing to cover themselves for some months ahead. But sellers are moving cautiously. Production costs are still high, and coke is expensive. Blast-furnace owners fear that they may have to pay even more than at present for their fuel. Furnace coke is scarce and prices are rising. The minimum figure for Yorkshire is £1 3s., but prices are running up to £1 5s. and more in isolated cases. Negotiations for pig iron supplies beyond the current quarter are accordingly not entertained by many smelters. In fact, they prefer to limit sales to six weeks or two months. With demand improving they have been able to advance prices and reimburse themselves for recent increases in coke. Northamptonshire forge iron has within the last few days realised as much as 73s. 6d. at furnace, or 82s. 6d. delivered in this district. Not so long ago it was quoted 70s., and later it went to 71s. 6d. Foundry numbers are 82s. 6d. at furnace. Derbyshire pig has also appreciated, 75s. to 77s. 6d. being asked for grey forge and 85s. for No. 3 foundry at furnace. Extravagant prices are occasionally named, but they do not represent the solid basis of business. Fairly heavy tonnages have been placed, and there is a lot of inquiry for Derbyshire iron for shipment to America. There appears to be no immediate prospect of additional furnaces getting to work locally, although the matter has been under consideration.

Galvanised Sheet Prices.

One of the strongest sections of the market this week is the sheet trade, galvanised sheets having made a sudden jump to £18 10s. per ton f.o.b. The market was hardly ripe for an advance of £1 in a week, but such proved to be the case, makers quoting £18 and following it up a few days later with a demand for £18 10s. Mills which quoted £18 10s. for 24 gauge corrugateds probably did so because they had as many orders on their books as they wanted. Serious sellers were open to do business between the figure named and £18. The increase is based upon the improved demand and the higher price for sheet bars. Spelter has been rather easy of late, and the price of this material has had no influence in the latest advance. For the time buying has been somewhat checked. Customers are grumbling at the rapidity of the advance in prices. Quite recently there was a relapse after a sudden spurt, and it is thought in some circles that history is likely to repeat itself. Many of the Staffordshire mills are finding steady occupation on special qualities. Tin-plates have further hardened, so that although the price is nominally 20s., it is not possible to make deals under about 21s. Lead-coated sheets are unchanged at 27s. per cwt. up to 20 gauge. The export trade is chiefly with the Continent, and is not showing much buoyancy.

Tinned Sheet Values Reaffirmed.

At the quarterly meeting of the Tinned Sheet Manufacturers' Association last quarter's prices were affirmed as follows:—Best charcoal to 20 gauge, 56s.; charcoal, 54s.; unassorted, 50s. per cwt. A moderately good demand from the Dominions was reported.

Proposed Wages Cut.

I learn that new and reduced rates of pay for the screw industry, proposed by the employers to the unions concerned, will probably become effective in the Birmingham and Midland area at the end of this month. Approximately the figures notified are the same as those enforced in the general engineering trades.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE general feeling of improvement in the iron and metal markets here has not been checked, and the reports brought back by members of the Exchange from the Birmingham quarterly meeting have helped to strengthen the belief that trade is at last on the turn. It is now nearly two years since Manchester received a cheerful report from Birmingham, and the alteration has perhaps rather more effect than is quite reasonable. Nevertheless, more optimistic feeling leads to more real improvement, for it has been partly the lack of confidence which has been keeping things back. There are, however, many considerations which should warn people against expecting too much. One of them is the possible disintegration of Germany as a result of the French military procedure. The collapse of Germany as an industrial country would have other consequences besides relieving some of our manufacturers from German competition.

Metals.

Prices for refined copper have not shown much change of late; but the demand in this country is a little better than it was, and no one seems to have any expectation of lower prices. It is not easy to say to what extent the consumption of refined copper is growing in Great Britain, but one may believe that it is growing, and this is something to the good. On the other hand, it is to be feared that copper consumption in Germany will be checked and perhaps stopped altogether for a time, and, as last year, Germany took far more copper from America than was taken by this country, the stoppage of this trade may have quite a bad effect on the market. One probable outlook for the market is that probably far more copper will be required this year for railway work, as it is quite likely that some of the savings in administration will be expended on new rolling stock. There has been not much change in the prices for manufactured copper and brass, but the lower prices for brass condenser tubes will be welcomed. These tubes are now at 1s. 1¾d. per lb., or 1¾d. per lb.—£14 per ton—above the official price of ordinary brass locomotive tubes. This is a more reasonable difference than has been charged for a long time; but the tube prices, as a whole, are still high, and a drastic revision of the whole list is eagerly awaited. The state of the tin market does not show much change. There was a little improvement in prices, and perhaps one may say that the demand in this country is somewhat better; but, of course, the prices do not now depend so very much on our domestic demand. America is the dominating factor just now, and at present she seems mainly to be buying for immediate delivery. There would seem to be some prospect of an improvement in the Welsh tin-plate trade, as recently some large orders have been placed in that district which should result in a greater consumption of tin. The market for lead has again been very strong, and rather higher prices have been paid. The tendency is for the "backwardation" to become rather less, and no doubt the fear of any sudden collapse of prices is much less than it was. On the other hand, this fear seems now to be transferred to the spelter market, and people are talking of probable lower prices, partly no doubt because the price of forward spelter is so much less than that for spot. The actual world supply of spelter is, however, not very large, and the consumption ought to be equal to it; at any rate, while the German output is kept low. The position as regards Australian spelter appears to be unaltered, but fears of a coal strike there are diminishing.

Pig Iron.

The markets here for foundry pig iron are certainly stronger than they were. As our readers know, many Lancashire ironfounders have been buying pig iron for forward delivery for some time, at prices equal to about 89s. or 90s. per ton delivered in Manchester, and one may expect that this prudential buying will turn out to be successful. Most sellers of Midland iron in Manchester are asking 92s. delivered for No. 3, although it may still be possible to buy at 91s. One doubts, however, whether any Derbyshire No. 3 can be obtained now at less than 91s. 6d. The Derbyshire makers are now aiming at 85s. per ton as a furnace price, and this would mean 93s. in Manchester. The advance in the prices of furnace coke, which has taken place during the last month or so, would justify more than the present advance in pig iron; so that the makers will not be much better off than they were before. Reports from Cleveland this week certainly suggest that the price of No. 3 in that district is going to be higher. There is a distinct shortage, and, in fact, it is said that there is now no No. 3 pig iron for delivery in January. Scotch pig iron remains very firm here, and is almost out of the reach of the ordinary ironfounder. Forge pig iron remains neglected and comparatively cheap.

Steel.

The improvement in the manufactured steel market continues, and the position here is very cheerful. Buyers seem quite willing to pay the higher price, and there is some question as to whether a further small advance is not possible. Naturally the makers want to

get on to a paying basis, and they have scarcely done this yet. Most of the steel works in the country are now asking from 10s. to 12s. 6d. per ton more than was the case a month ago.

Scrap.

The demand for scrap cast iron for foundry work is still not equal to the supply here, and, as a consequence, some of the dealers are rather weak. Good broken machinery scrap can still be bought here at under 85s. per ton. Heavy wrought scrap is firmer, and dealers here are talking of £4, but the ironworks have not yet paid more than 75s. Steel scrap is scarce and very firm.

Manchester Literary and Philosophical Society.

In its "Lit. and Phil." Manchester possesses one of the oldest institutions of the kind in the kingdom. In fact, it is claimed to be junior only to the Royal Society. Its venerable home in George-street possesses considerable historic interest. It was here that such great scientists as Dalton and Joule worked, and where the former carried out the experiments which led to the evolution of his atomic theory. Dalton was elected a member in 1794, and was President from 1817 to 1844. At his death he bequeathed all his chemical and other philosophical apparatus to his friend, Dr. Henry, by whom they were presented to the society. There is also in the library of the institution the diagram by which Dalton illustrated his lectures, and other relics. Later members of the society whose names have illuminated the world of science and literature, include Joseph Priestley, Sir Wm. Fairbairn, Richard Cobden, Sir Joseph Whitworth, Sir Henry Roscoe, Osborne Reynolds and Henry Wylde. With the object of bringing this historic building up to date, a sum of £1350 has recently been subscribed by members of the society for the purchase of a plot of land immediately behind the existing building, and upon this land it is proposed to build an extension, if a sufficient increase in the membership of the institution can be brought about. The cost of the present extension is estimated at about £8000, and it is hoped that there are sufficient men of scientific and literary attainments in Manchester to come forward and help to carry out the society's scheme.

BARROW-IN-FURNESS, Thursday.

Hematites.

The home trade continues to develop on satisfactory lines, and makers are experiencing a steady demand for future deliveries. Scotland is becoming a pretty extensive customer now, and fairly large cargoes are leaving West Coast ports for Glasgow. The Midlands continue to place orders for larger quantities, and there is just a possibility of another furnace or two going in in the early future. At Barrow a fourth furnace is being got ready in case of necessity. If the steel departments continue in work and take a large portion of iron, then it is almost certain that we shall see more furnaces in blast. It is said by some that the trouble in the German colliery districts is likely to affect the continental trade, and that already there is a slight hesitation on the part of some, but this will pass, it is confidently hoped. Business in special classes of iron continues to be satisfactory.

Iron Ore.

The iron ore trade is better than it has been for many months, and several mines are doing fairly well. Not much, however, is leaving the district, the consumption being mostly by local smelters. The trade in foreign ore is small, and minimum quantities are being imported until present stocks are reduced.

Steel.

There is more life in the steel trade, but makers are complaining of German competition which is seriously cutting British prices. The Barrow rail mills are likely to be employed right through to Easter. The rail mills in Cumberland are also at work and have orders that will carry them on for some time. The Barrow hoop mills are partially employed and foundries are busier.

Shipbuilding and Engineering.

There is nothing fresh to report as regards shipbuilding, and no new orders are announced, but it will not be long, it is believed, before there is better news. Engineering is improving. Vickers Limited are getting busier. They have received orders for the reconditioning of guns which were used during the war on merchant vessels. All these have to be thoroughly overhauled and reconditioned, and will then go into Admiralty stores. As each gun bears the number of the vessel on which it was originally mounted, and as each vessel still retains all the positions as originally prepared, in case of trouble each gun would be allocated to the ship it belongs to with a minimum of delay and expense. It is worth noting that this Admiralty work is given out on the understanding that only men who have been unemployed and on dole shall be brought in for the work. This means work for the unemployed and a reduction of payments of out-relief or doles. Several hundred 4in. guns will pass through the mechanics' hands.

SHEFFIELD.

(From our own Correspondent.)

Continued Improvement in Steel.

THE note of optimism on which it has been possible to base recent letters is still vibrating through the trade atmosphere. The improvement in the situation is well maintained, and is spreading to more sections. While it is still strongest in basic steel, it is increasingly apparent in acid steel, and is also extending to various manufactured products which have been suffering from acute depression during the last two or three years.

Poor Continental Business.

It is perhaps hardly necessary to say that the better demand for Sheffield goods is not on a world-wide scale. The financial conditions prevailing in Europe are such as to preclude many countries from buying English goods, and the Sheffield firms which depend mainly on trade with France, Germany, Belgium or Italy are by no means well off for orders. Against this is to be set the fact that Germany's power to compete must be affected by her present troubles, and this will be all to the advantage of local manufacturers.

Tram Rail Contract Lost.

Sheffield has during the week had the disappointment of seeing a valuable order, which it tried to obtain, sent abroad; but, on the other hand, it has derived satisfaction from the placing of other contracts with local firms. The disappointment was in respect of the 1000 tons of tram rails for the Hull Corporation, for which, as I reported last week, a Belgian firm quoted nearly £5000 less than Messrs. Steel, Peech and Tozer, of Sheffield. The Sheffield Chamber of Commerce did its best for the local firm, and wrote to the Hull Corporation pointing out that Sheffield manufacturers controlled a large and important volume of business passing through Hull, that they were large buyers of cement, and that at the moment important orders were being held up pending the decision on the rail contract, so that the interests of the two cities were more or less mutual. The appeal had no effect, however. The Hull City Council adopted the recommendation of its Tramways Committee to give the contract to Belgium, only three members voting in favour of accepting the Sheffield offer.

The Burden of Rates.

When writing on the subject of the Hull contract last week, I mentioned that the burden of local rates was probably one of the factors which impaired Sheffield's ability to compete with the Continent. Striking evidence of the extent of this handicap has since been given at an inquiry held by the Ministry of Health, at the instance of the Sheffield Ratepayers' Economy Committee, into the administration of poor law relief by the Sheffield Board of Guardians, on whom heavy calls have been made as a result of the long-continued trade depression. Representatives of several large firms attended and presented striking figures. The secretary of Cammell Laird and Co., Limited, for instance, stated that in the case of cast steel tires the cost per ton due to the rates had risen from 3s. 1½d. in 1914 to £2 0s. 11½d. in 1922. Of this, the call of the Guardians represented 6d. per ton in 1914 and 18s. 11d. in 1922. In the case of steel axles, the cost per ton due to the rates had gone up from 2s. 7½d. to £2 19s. 3½d. On behalf of Samuel Osborn and Co., Limited, it was stated that the cost per ton on steel in respect of the Guardians' call in 1914 was 8d., while for the year ending September, 1922, it was 13s. 4d. Other figures, not so high, but still serious, were given by Hadfields Limited, Vickers Limited, and Brown, Bayley's Steel Works, Limited. In the light of these statements, coupled with the well-known heavy incidence of railway charges, it is not difficult to understand that Sheffield has a hard task in keeping on level terms with continental rivals.

Large Railway Orders.

The satisfactory news to which I referred above includes one very important item in the fact that John Baker and Sons, Limited, of Rotherham, have booked an order from the East India Railway Company for 2300 pairs of broad-gauge wheels and axles with rolled steel disc centres. In the ordinary course of things, it is very probable that this order would have gone to Germany, and the French occupation of the Ruhr district is largely to thank for the fact that the work has come this way. The order represents approximately £100,000, and deliveries are to be spread over six months. With this and other orders that it has on hand, the firm will be able to provide full employment for something like 800 men during the period of the contract. Cammell Laird and Co., of Sheffield and Nottingham, are among the firms which have secured important contracts for rolling stock and other equipment for the Kassala Railway Company, Limited, having received an order for the supply of wagons and brake vans. The scheme of extensions which the London, Midland and Scottish Railway Company proposes to put in hand in the near future, at a cost of a million and a-quarter, will no doubt be of benefit to Sheffield trade. One of the principal works in the scheme is to be carried out in this district. It is a widening of the Manchester to Normanton railway at Mirfield and between Horbury and Wakefield, entailing an extensive remodelling of the permanent way and tunnelling works.

Colliery Developments.

The ordering of new wagons for the coal trade still goes on. During the past month or so, several large contracts have been placed with the various wagon-building companies in the British Isles, and it is fully anticipated that the revival that has set in will continue. At the annual dinner of the Yorkshire Coal and Coke Trades' Wagon Representatives, held in Sheffield last Saturday, a feeling of optimism was very evident. Coal wagons are now cheap—so cheap that some makers vow they are working without profit. It is reported that a contract has recently been placed for 12-ton coal wagons, such as would have cost £300 each during the boom of a couple of years ago, at £130 each, which is approaching pre-war price. The coal trade continues very brisk, and is being helped by the complications on the Ruhr. On Monday it was announced that the German State Railways had entered the Humber export market for the purchase of 50,000 tons of hard steam coal for shipment to a number of German ports during January and February. On all hands it is recognised that the output of coal must be improved by every possible means, and progress is being made with various new sinking schemes. Developments in the North Notts. coalfield are being pushed forward, and from Retford comes the news that the contractors for the Broughton and Ollerton colliery scheme can find work for 1000 men for four or five years.

Various Branches.

The ship-breaking firm of T. W. Ward, Limited, of Sheffield, is to break up three old warships at present lying in Monkstown Bay, Cork Harbour. It has secured from the Irish Ministry of Trade and Commerce a suitable site at the eastern end of Haulbowline Dockyard. The engineering departments of the city are finding an improvement in their position, and in some cases double shifts are being worked. The crucible steel trade is benefiting accordingly, but the revival is slow and depends chiefly upon the home market. The shipyards are making a good demand for tools and tool steels. Increased work is reported at the forges and foundries, but there is still a good deal of plant in the city that is not absorbed, and unemployment remains at a high level. Scrap iron prices are higher, heavy melting basic steel scrap having gone up 10s. a ton during the past few weeks, and the market for steel is harder. In the cutlery and plate trades the year has started pretty well. There is a well-maintained demand for stainless table cutlery, and among the orders recently placed are some good contracts from overseas.

Local Public Projects.

There are again a few municipal works schemes to call attention to. The Chesterfield Corporation is promoting a parliamentary Bill by which it is seeking very wide powers. In relation to tramways, it asks authority to convert the single line in Sheffield-road into a double track, and also to convert the tramways to the trackless trolley system if this should at any time be considered desirable. Powers are sought for the establishment of abattoirs and cold storage on land adjoining the cattle market. The new water scheme, to which I have previously referred, is included in the Bill, together with eleven street improvement schemes. At Eccles field, a new sewage works has been opened, which has provided work for over 150 of the local unemployed. The estimated cost of construction was £17,000, but the scheme has been carried out at a saving of £3980 on this sum. The Conisborough Urban Council has received the sanction of the Ministry of Health to borrow £6300 to complete expenditure on sewage works extension.

NORTH OF ENGLAND.

(From our own Correspondent.

Increased Activity.

INCREASING activity is the dominant feature in North of England industry. At long last business is beginning to flow more freely, and ere long it is confidently believed that the stream of trade will be in full spate once more. So far as the iron and steel trades are concerned the outlook is very satisfactory. Buyers are beginning to realise that nothing is to be gained by waiting, that prices have touched rock-bottom, and that stabilisation has been attained. That is the essential condition to industrial recovery. A falling market is always inimical to trade. If by waiting buyers see a prospect of saving money they are generally prepared to wait. But the advantage of delay has now disappeared. Prices, in fact, show a marked upward tendency in all branches. The general view is that the occupation of the Ruhr by the French, in its immediate effects at all events, will benefit British trade. Consumers on the Continent, who have been wont to draw supplies from Germany, may have to come here for supplies, and the prospects of an improved export trade are deemed to be favourable. Moreover, fuel prices on the Continent are leaping up, and pig iron rates are already moving up in sympathy, so that competition from the Continent is bound to be less keen.

Cleveland Iron Trade.

There has been considerable activity in the Cleveland iron trade this week. In all branches business has broadened out considerably, and now that prices are moving upward consumers are showing a keenness to purchase supplies. There is no reluctance on the part of consumers to cover forward as well as prompt requirements, but as costs of production are advancing and present prices leave little or no margin of profit, makers are not disposed to commit themselves too far ahead, and in regard to forward contracts are acting with caution. Prices show an advance on last week. It is recognised by Cleveland producers that too steep an advance might ruin the prospects of improved trade; but lately iron has been sold below cost, and it is natural that makers should take this opportunity of raising prices to a level which at least covers costs of production. Sales to home consumers have been very heavy of late, and good foundry iron is now scarce. Thus with the demand continuing makers have advanced their prices, and although for home delivery No. 3 G.M.B. Cleveland pig iron can be bought at 93s., the extra cost of putting iron f.o.b., has led to the export price being advanced to 94s. per ton. No. 1 is almost unobtainable, and the price is nominal at 97s. 6d. With No. 3 scarce buyers have been taking No. 4 foundry pretty freely, and as stocks have dwindled, the price has advanced to 89s., while No. 4 forge is firm at 85s., and mottled and white, of which there is very little available, at 80s. per ton.

Hematite Pig Iron.

A marked improvement is also reported in the East Coast hematite pig iron trade. Italy has been buying on a large scale, and as there is a very strong home demand, the price of mixed numbers has advanced to 94s., with No. 1 at 94s. 6d. per ton for both home and export.

Iron-making Materials.

The foreign ore trade has also assumed a very firm position. It is contended that in relation to other materials the price of ore is unduly low, and sellers seem determined to raise the price to more remunerative levels. All classes of ore have advanced in price, and best Rubio

ore is now firm at 23s. per ton. c.i.f. The rise, however, has not scared off buyers, and there have been some large transactions. The coke market is stronger than ever. America as well as the Continent is an eager buyer, and export prices are considerably above the rates quoted to home consumers. Cleveland ironmasters are having to pay 31s. per ton for good medium furnace coke delivered at the works, and in some cases more is quoted.

Manufactured Iron and Steel.

Marked improvement is reported in the manufactured iron and steel trade. From the shipyards there is now a steady flow of specifications, and there is also more activity in the export branch. The works are now very favourably situated for orders, and makers are grading up their prices. Common iron bars have advanced 10s. per ton to £11, steel boiler plates are now £13, steel ship plates £9 10s., steel joists, angles and heavy steel rails, £9; fish plates, £13; and steel channels, £9 5s. There is an enormous demand for galvanised sheets, and the prices are firmer.

The Coal Trade.

The Northern coal market remains in every direction firm and rigid, with no apparent possibility of discounting prices either for prompt or forward delivery at present. The general atmosphere, however, is somewhat tense and anxious, which is due entirely to the reparations question and the break up of the Paris Conference, followed by the French invasion of the Ruhr coalfields and industrial areas. Some of the influential people in the trade are of the opinion that the coal business stands to benefit whatever the upshot may be. But others view the situation with considerable concern and perturbation, seeing in the comparative quietness of the Germans all the possibilities of an internal upheaval. In the meantime, however, there is no cessation of inquiry from abroad, for in addition to the heavy call from Germany, France and Belgium, there is a fairly extensive inquiry from Norway and Sweden, which may develop into large bookings. Already a contract for about 50,000 tons of best Northumberland steam coals has been placed by the Swedish State Railways, the deliveries to be made over the next three months. Most of the collieries in both counties are in a very favourable position for some time ahead. In every case they are firmly indicating the top figures, and in some instances are inclined to put the prices up. Second-hand holders are also holding their hands, and are inclined to take advantage of a possible enhancement in values. A big drawback at the moment is the dislocation at the loading ports, and steamers are considerably delayed. There is decided room for improvement in the loading facilities in nearly every case. The Northumberland steam coal section is in a good position. Best Blyth steams are tight, while Tyne primes, as well as picked brands of Durham best screened are firm at full quoted prices. Second steams are improved, and are indicated a trifle higher either for screened or smalls. Gas coal collieries are well booked up with orders, and high prices are obtainable for any small supplies that come on to the market. Coking coals still make progress, as much as 24s. 6d. being paid for a good ordinary brand of unscreened. Bunker coals are also scarce, and are very firmly quoted. The coke trade is steady; for every kind of foundry, as well as gas makes, there is a brisk trade passing.

SCOTLAND.

(From our own Correspondent.)

Further Shipping Orders.

A GOOD start has been made at the shipyards on the lower reaches of the Clyde. New orders continue to come in, and the latest contracts mentioned include three cargo steamers, two of which are of 4300 tons, to be built at Burntisland, while the other is one of 8000 tons to be built at Scotstoun, Glasgow.

Pig Iron.

The resumption of buying in the Scotch pig iron market has been slow. The export inquiry is restricted, and makers are now looking to home consumers to improve matters. Foundry iron is in poor request at present, while hematite meets with slightly more inquiry than for some time back. Prices are nominally unchanged.

Firmer Tendency in Steel and Iron.

The steel and ironworks are practically all once more in operation. The steelmakers have a fair tonnage to overtake both in plates and sectional material, and also anticipate an improved demand from the shipyards. Steel sheets, also, are in a fair position. The export demand is comparatively steady, while home consumers are issuing more inquiries, especially for the heavier gauges. Galvanised sheets are busy. The bar iron works report an improvement in business, but makers are nevertheless somewhat disappointed with the slow expansion of local demands. The steel branch of this industry is much brighter. Good orders have been booked recently both for home and export delivery. A hardening tendency is noticeable in all steel and iron prices. Scrap materials are very scarce and also firmer in price.

Coal.

General conditions ruling the coal trade in Scotland show no change of note. The collieries have still comparatively good foreign orders on hand for round coal and treble nuts, but new business is very slow in coming forward. Only a very small amount of American business has been done so far. Generally speaking, any orders passing at present are confined to immediate requirements, and both buyers and sellers are fighting shy of forward business. Single nuts and smaller sizes are very difficult to dispose of, and some very keen prices are quoted for these qualities. Aggregate shipments for the week amounted to 261,538 tons against 134,325 tons in the preceding week and 200,139 tons in the same week last year. The home market continues dull, and demands are easily met. Municipal works and railways are taking regular supplies, but trade otherwise is of small account so far. An early increase in industrial requirements is anticipated. Export prices are practically all lower than in the preceding week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

AT the moment considerable uncertainty prevails regarding the outlook in the South Wales steam coal trade. For one thing, the action of the French Government in respect of Germany has complicated the position, and while the view is entertained in many quarters that the attitude of the Germans is likely to have the effect of bringing about a substantial demand from France for Welsh coals, this demand is not yet apparent, and is explicable by the fact that buyers in France are induced to display caution with regard to purchases owing to the very "jumpy" condition of the foreign exchange. It may be that later, when the political situation on the Continent becomes more settled, a much better inquiry than is now being experienced will be seen, but at the moment current business is comparatively quiet, and this applies not only to France but also to continental operations generally. At the same time the state of the steam coal market is certainly improved compared with what it was a week ago. The supply of tonnage is more ample to meet the requirements of collieries. Delayed steamers have come along, and the docks are well off in this respect, with the consequence that the market, while not free from easiness in some directions for spot loading, is, on the whole, steadier, and coalowners have optimistic views regarding prices obtainable for supplies for next month's shipment. Many collieries are fully stemmed for the remainder of this month and the early part of February, but whether their calculations are likely to prove correct depends upon factors which cannot be controlled. There must certainly be an improvement upon the current European demand if their ideas are realised. For one thing, there is no expansion at the moment in the orders for steam coals for America, and the latest report from the States that the expected strike of miners in the American mines is not likely to mature is, of course, not conducive to a lot of further business being arranged and whatever may be the correctness of this report, it will have a certain amount of sentimental effect upon the tone. During the past week or so the falling off in orders for the Northern range of ports has resulted in rates of freight declining from the highest point of 9s. 6d. to 8s. 3d. f.d., and the best that is now offering for fairly large tonnage is 8s. The P.L.M. railway of France is reported to have placed orders with several local firms of exporters for about 200,000 tons of large and small coals for delivery over the next six months, and there are several small inquiries for supplies over a period. Among these is one from the Egyptian State Railways administration for 35,000 tons of second Admiralty large or best Monmouthshire large steam coals to be delivered at Alexandria in cargoes of 5000 tons by March 25th, the cargoes to be delivered at intervals of five days. Tenders for this business have to be in at the Administration's London agency on the 22nd inst. Tenders have also gone in for the supply of 30,000 tons of superior large steam coals for the Mauritius Government, this quantity to be delivered in cargoes monthly of about 6000 tons as from the middle of March. The Norte Railway of Spain is also inquiring for about 20,000 tons of steam coals for shipment to various Spanish ports within about February 20th, and the Dutch State Railways want tenders for 10,000 tons of locomotive coals for delivery next month; but as regards this latter inquiry this business more often than not goes to the North.

Coalfield Matters.

The officials of the South Wales Miners' Federation are prosecuting their campaign against the non-unionist, but so far it has not had a very disturbing effect upon production, though strikes have been threatened. In some cases the non-unionists are reported to have fallen into line, but the Federation is a long way from having a 100 per cent. membership, which is what the officials aim at. So far as the Buxton award is concerned, there is not yet complete agreement on all points, and now the latest question to be raised is that of permitting shipments to be made to America in the event of there being a strike of miners in that country. One or two districts have sent in resolutions to the Executive Council urging that steps should be taken to prevent the supply of coal to America, and after considering the matter the Executive has referred the question to the Miners' Federation of Great Britain.

Railways and Coal Trade.

The secretary of the South Wales Coalowners' Association draws attention to a statement issued about a week ago by the Railway Companies' Association to the effect that the expansion in the volume of the traffic of the railways of the country has, as a result of the recent concessions, been accompanied by a contraction in gross revenue. He points out that the value of the statistics is in a large measure destroyed by the failure of the Railway Companies' Association to give the costs for the two periods compared. Summarising the figures for October, he shows that for October last the number of tons hauled was 19,355,984 and the receipts £3,610,482, these figures being an increase on those for October, 1921, of 4,311,981 tons and £300,081 respectively. These receipts were £350,000 more than in September, while the increase of £300,081 in October over October, 1921, compares with a £78,960 increase in September last over the gross receipts in September, 1921. That expansion in revenue is on the coal hauled. In addition, the railway companies shipped in October, 1922, over three million tons more than in October, 1921, and on the whole of this the railway companies have had the benefit of the present high dock charges. To Mr. Gibson these statistics prove clearly that the revenue of the railway companies, instead of suffering, has benefited from the concessions which have been made, and that they justify the demand of the traders for still further substantial concessions.

Current Business.

On the whole, the tone of the market is quiet, as very little fresh inquiry is coming forward for prompt shipment of coals, but at the same time, inasmuch as a good deal of delayed tonnage has come to hand, the market is steadier than a week ago, and as order books are pretty full coalowners are quoting 29s. for best Admiralty large for February shipment, and second Admiralty large is quoted at 28s. to 28s. 6d. The feature of the market has been the advance in the prices of small coals, which are scarce on account of the more restricted working of the collieries of late. Many salesmen have declined to sell small coals unless buyers are prepared also to take large, and in cases where smalls alone are sold the price is frequently 1s. 6d. higher than would be the case if a proportion of large coals were purchased as well. For smalls themselves the collieries are demanding 19s. 6d. for the best, though they are almost unobtainable for prompt shipment, and even for ordinary cargo descriptions sales have been effected at 17s. 6d. Foundry coke is a firm market, and pit-wood is easier, but in the case of patent fuel there is practically no market at all, as makers will not quote ahead as the position in respect of pitch is still acute. Some makers are indicating as much as 37s. 6d.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

THE tin-plate market is quite firm, and works are now very well booked up for some little time ahead. The South Wales Siemens Sheet Association has decided to advance the price of tin-plate bars from £7 13s. 9d. to £8 1s. per ton, subject, of course, to the rebate of 7s. 6d. to the tinworks. The probabilities are that tin-plate makers will advance their prices to cover the increased cost of bars to them.

New Pipe Line.

The Cardiff City Council will shortly have placed before it proposals for a new pipe line from the reservoirs at Cwmtaff to Cardiff. This new pipe line is estimated to cost £500,000, and will take three or four years to complete. The section between Llwyn-on and Pontypridd will be made first, and tenders are already in hand for the supply of pipes, but they have not yet been considered, and the Waterworks Committee has not decided whether the pipes should be steel, cast iron, or concrete. This question is at the moment holding up the matter. The work will mean extra employment, and it is estimated that wages amounting to about £120,000 will be paid out.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THOS. H. HOWELL, Limited, iron and steel merchants, of Newport, Mon., asks us to state that it has opened an office at 65, Fenchurch-street, London, E.C. 3.

SIR WILLIAM NOBLE, formerly Engineer-in-Chief to the General Post Office, has joined the board of directors of the Walker-Weston Company, reinforced concrete engineers, 7, Wormwood-street, London.

WE are informed that Mr. W. Howard Wadmore has resigned his position with the Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, to take up an appointment with the Ateliers de Constructions Electriques de Charleroi, 56, Victoria-street, London.

THE BRITISH THOMSON-HOUSTON COMPANY, Limited, announces the appointment as managing director of Mr. W. C. Lusk, who has been director in charge of the sales department of the company for a number of years. Mr. H. C. Levis, who held the position of chairman and managing director, continues as chairman of the company.

WE are asked to state that Mr. William H. Hutchinson has joined the board of Sir William Arrol and Co., Limited, engineers and contractors, of Glasgow and London. Mr. Hutchinson, who will look after the general contracting side of the business, was, up to the end of last year, a partner in the firm of Messrs. Baldry, Yerburgh and Hutchinson, general contractors, of Westminster. The headquarters of the general contracting department of the firm will be transferred to London.

CONTRACTS.—J. Blakeborough and Sons, Limited, have recently secured from the Argentine Republic a contract for the supply of various sluice, disc and reflux valves, also a large number of fire hydrants. This order was, we understand, obtained in the face of both German and American competition. —The Aster Engineering Company, Limited, of Wembley, Middlesex, has secured a contract to supply three 25 horse-power Aster paraffin engine-driven air compressor sets for the operation of fog sirens at Duncansby Head fog station, to the order of the Northern Lighthouse Board.

GRINDING.—We have just received from the Norton Company, of Worcester, Mass., a copy of a book entitled "Grinding," which is obviously published as part of that company's propaganda, but in which there is a great fund of information relating to grinding generally of special value to practical engineers. The subject is dealt with right through from the manufacture of the abrasives and the wheels to the most delicate precision grinding. As instances of the thorough manner in which the volume treats of the subject, it may be mentioned that instructions for the proper grinding of twist drills are given, and hints included on the calipering of rough turned forgings.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	21/6
(1) N. African	21/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 14 0	4 14 0
No. 1	4 14 6	4 14 6
Cleveland—		
No. 1	4 17 6	4 17 6
Silicious Iron	4 17 6	4 17 6
No. 3 G.M.B.	4 13 0	4 14 0
No. 4 Foundry	4 9 0	4 9 0
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	3 15 0 to 3 17 6	
,, ,, Foundry	4 5 0 to 4 7 6	
(3) Northampton—		
Foundry No. 3	4 2 6	—
,, Forge	3 12 6	—
(3) Derbyshire—		
No. 3 Foundry	4 3 6 to 4 5 0	
Forge	3 15 0 to 3 17 6	
(3) Lincolnshire—		
Basic	4 0 0	—
Foundry	4 2 6 to 4 3 6	
Forge	4 0 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	11 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	11 10 0 to 12 0 0	
Best ,,	12 10 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 15 0 to 11 0 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 17 6 to 10 0 0	
Gas Tube Strip	10 15 0 to 11 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 0 0	—
Ship Plates ½in. and up	8 15 0	—
Sections	8 7 6	—
Steel Sheets ⅛in. to ½in.	10 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 10 0	—
Angles	9 0 0	—
Boiler Plates	13 0 0	—
Joists	9 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0 to 14 0 0	
Channels	9 5 0	—
Hard Billets	8 15 0	—
Soft Billets	8 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 15 0	—
Light ,,	9 15 0 to 10 5 0	
Billets	8 15 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Intermediate Basic	8 10 0	—
Soft Basic	7 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	7 15 0 to 8 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	18 0 0 to 18 10 0	
Angles	9 0 0 to 9 5 0	
Joists	9 0 0 to 9 5 0	
Tees	10 0 0	—
Bridge and Tank Plates	9 10 0 to 9 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/6 to 21/-
Block Tin (cash)	180 17 6
,, (three months)	182 10 0
Copper (cash)	63 10 0
,, (three months)	64 2 6
Spanish Lead (cash)	26 15 0
,, (three months)	26 5 0
Spelter (cash)	35 2 6
,, (three months)	33 12 6
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	71 0 0
,, Strong Sheets	96 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 1½
Lead, English	28 0 0
,, Foreign	26 15 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£54 0 0	20/-
,, ,, 1 p.c. ,,	£64 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1/7 per lb.	
Metallic Chromium	4/9 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£11 2 6 scale unit	5/- per
,, ,, 75 p.c.	19 10 0 scale unit	6/- per
,, Vanadium	17/- per lb.	
,, Molybdenum	9/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£32 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	22/6
,, ,, Ell	23/6
,, ,, Splint	24/- to 26/-
,, ,, Trebles	23/3
,, ,, Doubles	21/6
,, ,, Singles	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	22/6
,, ,, Splint	24/-
,, ,, Trebles	23/3
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	21/6 to 25/-
Screened Navigation	26/-
Trebles	24/-
Doubles	22/6
Singles	18/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	23/6
Secondary Steam	22/9
Trebles	23/9
Doubles	22/-
Singles	18/6

ENGLAND.

(8) N.W. COAST—	
Steams	29/-
Household	46/6 to 57/6
Coke	36/-
NORTHUMBERLAND—	
Best Steams	24/6 to 25/-
Second Steams	21/6 to 22/6
Steam Smalls	13/6 to 15/6
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	24/- to 25/-
Second	22/- to 23/-
Household	25/- to 28/-
Foundry Coke	37/- to 40/-

SHEFFIELD—	INLAND.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	24/- to 26/- —
,, ,, House	21/6 to 22/6 —
,, ,, Large Nuts	19/6 to 22/6 —
,, ,, Small ,,	15/- to 16/6 —
Yorkshire Hards	20/- to 21/- —
Derbyshire ,,	19/- to 20/6 —
Rough Slacks	9/- to 11/- —
Nutty ,,	7/9 to 9/9 —
Smalls	3 - to 5/- —
Blast Furnace Coke (Inland and Export)	22/- to 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28 6 to 29/6
Second ,, ,,	27/6 to 28/6
Best Dry Large	28/- to 28/6
Ordinary Dry Large	27/- to 28/-
Best Black Vein Large	27/- to 27/6
Western Valley ,,	26/6 to 27/-
Best Eastern Valley Large	26/6 to 27/-
Ordinary ,, ,,	24/- to 26/-
Best Steam Smalls	18/6 to 19/6
Ordinary ,,	15/- to 18/-
Washed Nuts	25/- to 32/6
No. 3 Rhondda Large	29/- to 30/-
,, ,, Smalls	19/- to 21/-
No. 2 ,, Large	24/- to 25/-
,, ,, Through	19/6 to 22/6
,, ,, Smalls	14/- to 15/-
Coke (export)	40/- to 45/-
Patent Fuel	—
Pitwood (ex ship)	28/6 to 29/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	32/6 to 35/-
Seconds	30/- to 32/6
Red Vein	28/- to 29/-
Machine-made Cobbles	42/6 to 45/-
Nuts	52/6 to 55/-
Beans	42/6 to 45/-
Peas	21/- to 23/-
Breaker Duff	11/- to 11/6
Rubbly Culm	14/- to 14/6
Steam Coals:	
Large	25/- to 26/-
Seconds	23/- to 25/-
Smalls	10/- to 12/-
Cargo Through	17/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(*From our Correspondent in Paris.*)

The Ruhr.

THE seizure by the French of the collieries and industrial establishments in Essen has had a certain steadying effect upon the metallurgical industries at home, which have long regarded this move as the only means possible of providing iron and steel firms with the necessary raw material. French, Belgium and Italian engineers have embarked upon a mission that is unique of its kind. They are to supervise the output of coal and coke, and, if necessary, they will replace German engineers who may fail to show sufficient devotion to their duties. The details of the mission are said to have been so thoroughly worked out that there can be little doubt as to its ultimate success; but so much depends upon the attitude of the German miners and operatives that the task may not be quite so easy as is expected, in which event the military force may be required to exercise pressure in other directions. Considering how easily industrial operations can be paralysed by ca' canny strikes, for which it is difficult to find a remedy, the possibility of the German workers submitting to the occupation and mutely protesting by labouring to do as little as possible is a contingency that must be taken into account. The French hope that they will enter into the good graces of the German miners by the offer of sufficiently high salaries and by an improvement in the food supplies. The miners have been complaining for some time past of the starvation rations they allege they have been receiving, and if the French occupation should bring forth abundance and prosperity for the local populations, it is quite possible that France will obtain some satisfaction. It remains to be seen whether the duties of the military force will be confined to protecting the Allied engineers, who may find themselves confronted with an extremely arduous task if the men should follow the example of the coalowners and leave the French in solitary possession.

Continuous Brakes.

The problem of the continuous brake for goods trains has suddenly entered upon a new phase in consequence of the necessity of taking measures immediately to meet the competition of Kunze-Knorr brake, which is making such rapid progress on the Continent as to lead to the belief that it will be definitely adopted in most countries before the French have completed their selective tests. In Germany 30,000 trucks are said to be equipped with the K.K. brake, while it is being employed in Norway and Sweden and is making headway in Switzerland, Italy, and elsewhere. The Germans even offered to supply the brake to France on account of reparations. Meanwhile, after the tests carried out in France with the Westinghouse, Lipkowski and Clayton-Hardy brakes, the Commission reported in favour of the Westinghouse, but the three experts to whom the report was submitted by the Minister of Public Works concluded that sufficient importance had not been given to the superiority of the Clayton-Hardy system in holding and stopping trains on steep down gradients, and proposed therefore that a certain number of trains should be equipped with the three systems of brakes and run for long periods under actual service conditions. The Superior Railway Council, however, is of the opinion that in view of the growing vogue of the K.K. brake, which is being vigorously pushed by the Germans, it would be dangerous to waste further time on trials, and the Commission to which it submitted the two reports came to the conclusion that the Westinghouse brake should be recommended for adoption. As the K.K. is also a compressed air brake, I understand that it can be used in conjunction with the Westinghouse.

Machinery Trade.

The recently published details of the foreign business in machinery during the first eleven months of last year show a declension both in imports and exports. The quantity of steam engines and other prime movers imported was 136,630 tons, as compared with 204,900 tons in the similar period of 1921; boilers, 15,350 tons, as against 21,090 tons; and machine parts, 26,180 tons, as compared with 44,760 tons. The contraction in values was relatively larger than the falling off in tonnage. The exports of steam engines and other prime movers amounted to 46,033 tons, as compared with 57,245 tons; boilers, 3580 tons, as against 6407 tons; and machine parts, 25,711 tons, as compared with 34,072 tons. There was relatively a notable improvement in values on account largely of the depreciation of the franc.

The Sahara Motor Trip.

The five motor cars fitted with rubber endless tracks, which left Touggourt, to the south of Algeria, for the Niger Valley, arrived at Timbuctoo without apparently any serious trouble on the way. The run occupied about twenty-one days, whereas the caravans that constitute the only other means of transport take three months to complete the journey. This performance is regarded in France as marking an epoch in the history of the African Colonies by opening up rapid communication between Algeria and the Niger Valley, since there appears now to be no impediment to the supplying of landing stages across the desert with what is necessary for a regular aviation service. Meanwhile the question of constructing a railway has not been abandoned. Little is heard of the original proposal for a line across the desert by the route followed approximately by the motor cars, but very strong claims are being put forward in favour of the Mauritanian Railway, which will put Casablanca into communication with St. Louis and Dakar and consequently with the Niger Valley; and the Oran Chamber of Commerce is now urging upon the Government to take immediate steps for the prospecting of a railway along the caravan route from Oran to the Niger by way of Colomb, Bechar and Aoulef, which is said to be the shortest and easiest and to pass through territories where there is plenty of water and even coal for the locomotives.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

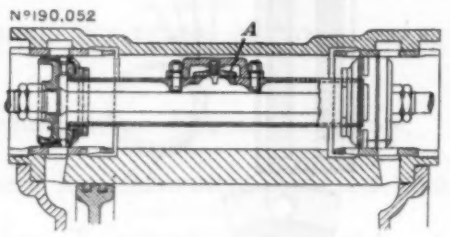
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

190,052. February 3rd, 1922.—RELIEF VALVES, H. P. M. Beames, Chester-place, Crewe.

THIS valve is intended for relieving excessive compression pressure in steam cylinders having trick-ported piston valves and for relieving the air pressure when a locomotive is running

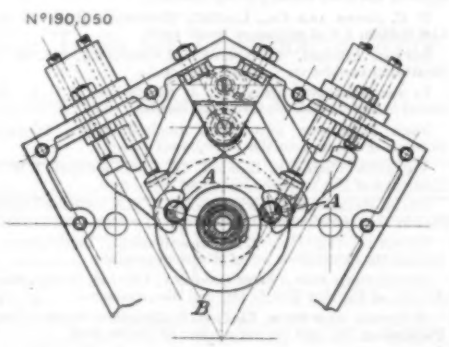


with the steam cut off. It takes the form of a mushroom valve A opening outwards from the passage through the valve. The arrangement is only applicable to engines with inside admission, as the steam pressure in the chest is relied upon to keep the valve closed normally.—*December 14th*, 1922.

INTERNAL COMBUSTION ENGINES.

190,050. January 28th, 1922.—VALVE GEAR, H. Hagens, 46, Strawberry Hill-road, Twickenham.

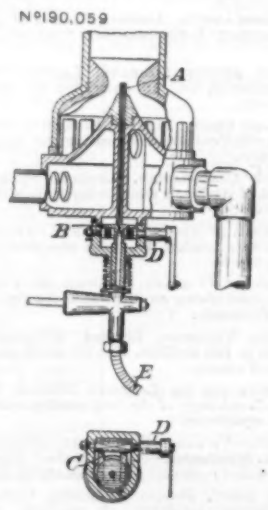
It appears that the inventor hopes to reduce the friction between the rockers, used to actuate the valve tappets, and the cam by introducing rollers A A lying in recesses in the ends of



the rockers. The recess embraces slightly more than half the circumference of the roller, in order to prevent it falling out, while discs B on the cam shaft stop the rollers from escaping endways.—*December 14th*, 1922.

190,059. February 14th, 1922.—CARBURETTERS, W. Pickard, 536, Claremont-road, Rusholme, Manchester.

In this carburetter the jet A is raised or lowered in the throat of the inlet in accordance with the richness of the desired mixture. The jet is formed as a long tube with a flange B that

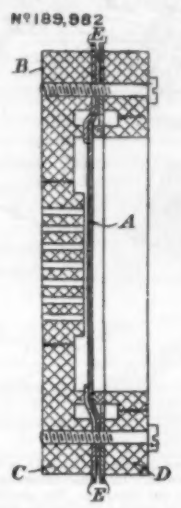


engages with arms C on a rocker shaft D. This shaft is operated in any convenient manner to raise or lower the jet. The fuel is supplied through a flexible pipe E.—*December 14th*, 1922.

TELEGRAPHS AND TELEPHONES.

189,982. November 23rd, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTROSTATIC TELEPHONES, Joseph Massolle, of 60, Cunostrasse, Grünewald, Germany; Hans Vogt, of 5, Königsweg, Schöneberg, Germany; and Josef Engl, of 17, Oberstrasse, Grünewald, Germany.

In electrostatic telephones, in which the diaphragm forms or carries what is in effect one coating of a condenser, the distance between the diaphragm and the other condenser coating is of great importance, and as these parts must be well insulated from one another it is not easy to make the space between them no greater than a few hundredths of a millimetre. According to this invention all the parts which determine the gap between the condenser plates are formed of metal, with the exception of rings of insulating material, which are firmly clamped between

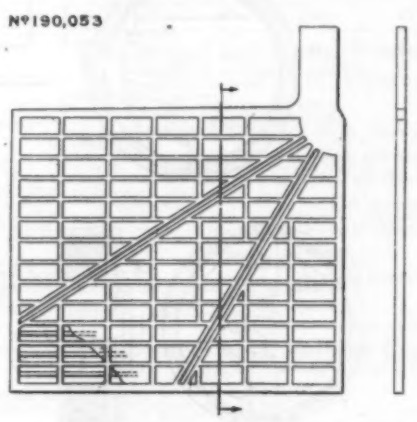


the metallic parts. In the drawing A is a metal supporting plate consisting of a piece of metal foil or of non-conducting material which is coated with electrically conducting material on both sides. The base plate C is insulated from the part D by layers of thin mica E, and for making an electrical connection with the diaphragm thin strips of metal foil are used.—*December 14th*, 1922.

BATTERIES AND ACCUMULATORS.

190,053. February 7th, 1922.—STORAGE BATTERY GRID, Arthur Owen Garrett, of 3553, Twenty-eighth-street, San Diego, California, U.S.A.; Christopher Ellsworth Funnell, of 225, Merchants' National Bank; and William Leroy Hoffman, of 225, Merchants' National Bank, both of Los Angeles, California.

This specification describes a storage battery grid of that type in which a rectangularly shaped frame is divided into a plurality of distinct expansion sections by oblique supporting members,

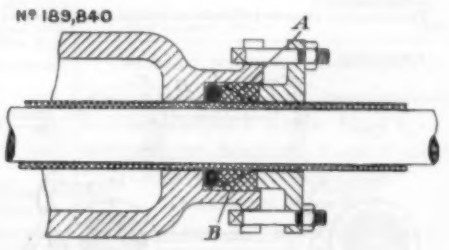


including slots extending through these supporting members, the grid being also provided with vertical and horizontal supporting partitions parallel with the sides of the grid.—*December* 14th, 1922.

TRANSMISSION OF POWER.

189,840. August 6th, 1921.—IMPROVEMENTS IN GLANDS OF ELECTRIC JOINT BOXES, Charles James Beaver, of Rangemoor Crescent-road, Hale, Cheshire, and Ernest Alexander Claremont, of Forest Edge, Dunham Massey, Cheshire.

The object of the gland described in this specification is to enable a good electrical bond to be made between the metal



sheath of the cable and the joint box. Two annular lead wedges A and B are interlocked as shown, and pressure is applied to these wedges by tightening up the nuts of the gland.—*December 6th*, 1922.

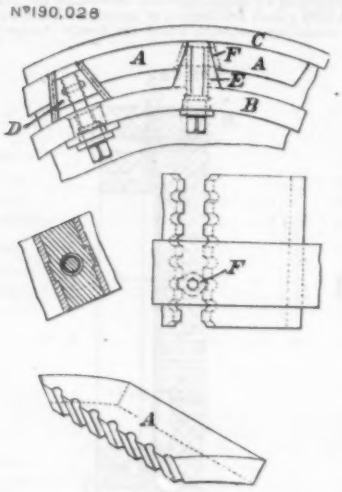
MACHINE TOOLS AND SHOP APPLIANCES.

190,028. January 4th, 1922.—GRINDING WHEELS, T. Lumsden, Alexandra Works, Gateshead-on-Tyne.

This invention relates to grinding wheels fitted with segmental grinding blocks and used for face grinding. The blocks A A are held between an inner ring B and outer ring C and are

clamped by wedge pieces D, which are forced outwardly by the screws shown. The blocks have one side grooved, as shown in the lower view, and the other side plain. They are put in place so that the grooved and plain sides face one another. The plain

N°190,028



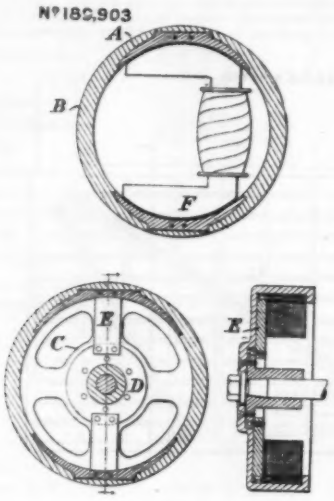
sides are acted upon by the wedges D, while the grooved sides face the abutments E. In these abutments there are stops F which engage with the grooves. By slacking off the stops and wedges the grinding blocks can be drawn forward to take up wear and positively fixed again.—*December 14th*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

189,903. September 20th, 1922.—IMPROVEMENTS IN AND RELATING TO MAGNETO-ELECTRIC MACHINES, The British Thomson-Houston Company, Limited, Crown House, Aldwych, W.C. 2, and Arthur Primrose Young, of "Dovedale," Kenilworth, Warwick.

This invention relates to magneto-electric machines and more particularly to machines which are of the fly-wheel type. The magnetic pole pieces A are preferably laminated and are cast in or otherwise secured to the rim B of a fly-wheel C of non-magnetic material, such as phosphor-bronze. The fly-wheel is secured to a boss D of steel or other magnetic material mounted on the shaft and the steel boss is connected to the pole pieces

N°189,903



A by means of short bar magnets E of cobalt steel or other highly magnetic material, the magnetic circuit between the bar magnets E being completed through the steel boss D. The armature F is mounted relatively to pole pieces as shown in the upper drawing. A construction such as above described enables a small fly-wheel type of magneto to be built, which is considerably cheaper to manufacture than those at present on the market.—*December 14th*, 1922.

MISCELLANEOUS.

190,086. May 19th, 1922.—SEWAGE CAKE BREAKER, D. Harvie and D. Harvie, Clydebank Works, Dalmarnock Bridge, Rutherglen.

The inventors propose to break up sewage cake by means of a

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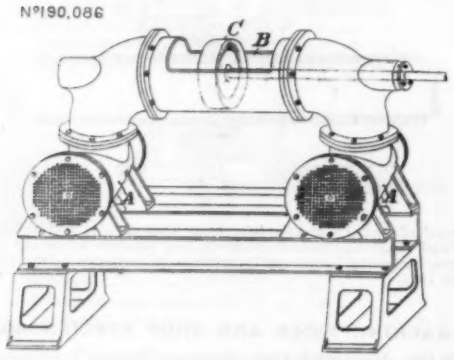

pair of machines similar to those used in the kitchen for mincing meat. These machines are shown at A A and have rotary cutters working behind the perforated plates shown. The cake is fed into the opening B and forced into one or the other of the machines by means of the plunger C.—*December 14th*, 1922.

189,955. October 31st, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRIC CONDENSERS, The British Thomson-Houston Company, Crown House, Aldwych, W.C. 2.

The condenser described in this specification consists of an outer metallic casing A, in the centre of which is a tubular member B, which is perforated at C, the outer casing and central

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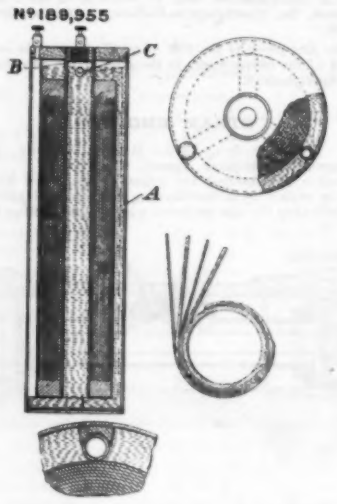

tube being fitted with liquid insulating material. Around the centre tube conducting sheets and sheets of insulation are wound, as shown in the lower right-hand drawing, one set of conducting sheets being in electrical connection with the tube and the other with the casing.—*December 14th*, 1922.

Catalogues.

F. C. SCHMIDT, 82, Victoria-street, S.W. 1.—Illustrated catalogue of the Mars metal parting machine.

T. C. JONES AND CO., Limited, Shepherd's Bush, W. 12.—List Section 1/8 of engineers' small tools.

SOFNOL, Limited, Westcombe-hill, Greenwich, S.E. 10.—An illustrated booklet on "Water Testing."

LIONEL ROBINSON AND CO., 3, Staple-inn, W.C. 1.—Illustrated leaflet on Ballsok insulating beads.

JOHN MUSGRAVE AND SONS, Limited, Globe Ironworks, Bolton.—Pamphlet on the Radojet air pump.

VICTAULIC COMPANY, Limited, 28, Victoria-street, S.W. 1.—Catalogue of the Victaulic leakproof pipe joint.

CRANE PACKING COMPANY, Chicago, U.S.A.—Booklet explaining the new metallic packing condenser process.

DONOVAN AND CO., 47, Cornwall-street, Birmingham.—A copy of the firm's price list of electrical supplies.

BIRMINGHAM SMALL ARMS COMPANY, Limited, Birmingham.—A copy of the new B.S.A. tap and die catalogue.

T. COOKE AND SONS, Limited, Buckingham Works, York.—Publication No. 542 on the subject of clinometers.

CASEY, BEAN AND CASSELLS, Bradford.—List No. 822, treating of the firm's "Super" improved rim friction clutch.

WM. WADSWORTH AND SONS, Limited, Bolton.—An illustrated catalogue concerned with the Wadsworth electric lift.

BOLCKOW, VAUGHAN AND CO., Limited, Middlesbrough.—Catalogue of silica and fire-clay refractory products.

TANGYES LIMITED, Birmingham.—Catalogue No. 283, dealing with the Tangye heavy oil engine, cold starting type.

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham.—A new brochure dealing with the Stanton-Hume concrete pipes.

JAMES GORDON AND CO., Limited, Windsor House, Kingsway, W.C. 2.—Illustrated leaflet entitled "Water, the Cheapest Power."

THE ALDEN ENGINE COMPANY, Limited, Crown Works, Oxford.—Publication No. 110, describing the Alden oil engines and lighting sets.

CUNLIFFE AND CROOM, Limited, Broughton Ironworks, Manchester.—A pocket catalogue indicating the range of machines made by the firm.

POWER GAS CORPORATION, Limited, Stockton-on-Tees.—Illustrated list of the firm's manufactures made under the Mond and Lymn patents.

THE DOWSON AND MASON GAS PLANT COMPANY, Limited, 3, Manchester-street, London, W. 1.—A pamphlet on the storage and handling of oils.

OCEAN SALVAGE COMPANY, Limited, 28, Fenchurch-street, E.C. 3.—Pamphlet giving an illustrated description of the new salvage ship Dalhousie.

PADLEY AND VENABLES, Limited, Hill-street, Sheffield.—New catalogue in two sections, viz., for steels and tools used in engineering and mining.

G. A. HARVEY AND CO (LONDON), Limited, Woolwich-road, London, S.E. 7.—A copy of the new catalogue dealing with the Harvey steel equipment.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Limited, Trafford Park, Manchester.—A copy of the "Cosmos" calendar and lamp showcard; also the new domestic appliance showcard.

PRATCHITT BROS., Denton Ironworks, Carlisle.—An illustrated descriptive catalogue of pumping and hydraulic machinery, disintegrators, crushers, colliery and chemical plant.

RICHARD JOHNSON, CLAPHAM AND MORRIS, Limited, Lever-street, Manchester.—Pamphlet on "Jacem" diamond steel battery screening, tables of apertures, discharge areas, wire gauges.

RUSTON AND HORNSBY, Limited, Lincoln.—Circular No. 4249, dealing with the "Ruston" No. 10 universal excavator; also publication No. 4318, describing the "Ruston" No. 30 steam shovel.

FERGUSON, PAILIN, Limited, Edward-street, Higher Openshaw, Manchester.—Catalogue, Section 160/A2, on industrial and mining gear, types B and C, ironclad oil-immersed circuit breakers, &c.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, S.W. 1. Symposium of papers on "Indicators." 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Soap Films as Detectors: Stream Lines; Vortex Motion and Sound," by Sir James Dewar. 9 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "Laminated Springs," by Mr. T. H. Sanders. 7.30 p.m.

ROYAL SOCIETY OF ARTS: INDIAN SECTION.—John-street, Adelphi, W.C. 2. "A Clash of Ideals as a Source of Indian Unrest," by the Earl of Ronaldshay. 4.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Philosophical Hall, Leeds. Paper, "The Legal Aspect of Underground Water," by Mr. H. F. Bidder. 7.30 p.m.

SATURDAY, JANUARY 20TH.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-EASTERN SECTION.—Visit to the Pallion Engine and Shipbuilding Works of W. Doxford and Sons, Limited.

MONDAY, JANUARY 22ND.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W. 1. Informal discussion, "The Value of College Training to Engineers." 7 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, George-street, Glasgow. "Mechanical Transport and some of its Problems" (slides), by Professor W. E. Dalby. 7.30 p.m.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "The Manufacture and Uses of Acetylene Gas," with cinematograph film, by Allen-Liversidge, Limited, of Hull. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Informal discussion, "Insulators and Insulating Materials." 7 p.m.

TUESDAY, JANUARY 23RD.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower-hill, E. 1. Film illustrating works of W. Beardmore, Limited. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Paper, "The Technique of Calculation," by Mr. James Watt. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Meeting of Coventry Graduates. Paper, "Piston Rings," by Mr. G. H. Day. 7.45 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-EASTERN SECTION.—Armstrong College, Newcastle-upon-Tyne. Paper, "The Desert Campaign and Advance on Jerusalem," by Professor Morrison. Ladies invited. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Papers: "Railway Economics for Extra-European Railways," and "Reinforced Concrete on the Chinese Railways," by Mr. H. Stringer. 6 p.m.

WEDNESDAY, JANUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Birmingham graduates to the works of the Gear Grinding Company, Limited, Handsworth. Meet outside the works. 2.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Education Offices, Salford. Paper, "Railless Trolley Traction," by Mr. C. W. J. Taffs. 7.30 p.m.

WOMEN'S ENGINEERING SOCIETY.—26, George-street, Hanover-square, W. 1. Lecture, "Mechanical Injection of Fuel as Applied to Diesel Engines," by Miss V. Holmes. 6.15 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Neville Hall, Newcastle-upon-Tyne. "Types of Ships and Reasons for their Suitability for Particular Trades," by Messrs. H. K. Rodgers and F. McAllister. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Informal meeting. "New Factors in the Reconditioning of Trunk Highways and their Bridges," by Mr. R. G. H. Clements. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—92, Victoria-street, S.W. 1. South-Eastern District meeting. 4.30 p.m.

THURSDAY, JANUARY 25TH.

LIVERPOOL ENGINEERING SOCIETY.—Midland Adelphi Hotel, Liverpool. Annual dinner. 7 p.m.

THE INSTITUTION OF STRUCTURAL ENGINEERS.—Denison House, 296, Vauxhall Bridge-road, S.W. 1. Paper, "The Relations between the Architect and the Engineer," by Mr. W. J. H. Leverton. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—The Engineers' Club, Coventry-street, W. 1. Annual general meeting. "The Internal Combustion Locomotive for Railway Work," by Mr. J. S. Tritton. 7 p.m.

THE OPTICAL SOCIETY.—Imperial College, Imperial Institute-road, South Kensington, S.W. 7. Lecture, "The Birth of Cinematography and its Antecedents," by Mr. W. Day. 7.30 p.m.

FRIDAY, JANUARY 26TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "K.V.A. and its Measurement," by Mr. G. F. Shotter. 7.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, St. George's-square, Sheffield. Paper, "Electric Furnaces," by Mr. A. G. Lobley. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Machinery of Anti-bacterial Defence," by Sir Almroth Wright. 9 p.m.

NEWCOMEN SOCIETY.—Queen's College, Paradise-street, Birmingham. Paper, "Some Notes on Windmills to the Commencement of the Nineteenth Century," by Mr. A. Titley. 6 p.m.

SATURDAY, JANUARY 27TH.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Neville Hall, Newcastle-upon-Tyne. "Metals Used in Engineering," by Mr. H. Dean. 2 p.m.

WEST YORKSHIRE METALLURGICAL SOCIETY.—City Museum, Leeds. Symposium of papers on "Casting of Metals."

MONDAY, JANUARY 29TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Meeting of Loughborough graduates. Paper, "Some Notes on Current Motor Cycle Design," by Mr. A. K. Harvey. 7 p.m.